



(11) **EP 2 953 847 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
29.11.2017 Bulletin 2017/48

(51) Int Cl.:
B63B 27/24 ^(2006.01) **B63B 27/34** ^(2006.01)
B67D 7/32 ^(2010.01) **B67D 9/00** ^(2010.01)

(21) Application number: **14705064.5**

(86) International application number:
PCT/EP2014/052137

(22) Date of filing: **04.02.2014**

(87) International publication number:
WO 2014/122122 (14.08.2014 Gazette 2014/33)

(54) **ARRANGEMENTS AND A METHOD FOR CONNECTION AND DISCONNECTION OF AT LEAST ONE HOSE CARRYING FLUID ESPECIALLY LNG AND/OR VAPORIZED LNG**

ANORDNUNGEN UND VERFAHREN ZUR VERBINDUNG UND TRENNUNG VON MINDESTENS EINEM SCHLAUCH MIT EINER FLÜSSIGKEIT, INSBESONDERE FLÜSSIGERDGS UND/ODER VERDAMPFTEM FLÜSSIGERDGS

AGENCEMENTS ET PROCÉDÉ D'ACCOUPLEMENT ET DE DÉSACCOUPLEMENT D'AU MOINS UN TUYAU SOUPLE ACHEMINANT UN FLUIDE, EN PARTICULIER DU GAZ NATUREL LIQUÉFIÉ ET/OU DU GAZ NATUREL LIQUÉFIÉ VAPORISÉ

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(30) Priority: **05.02.2013 US 201361760671 P**
02.07.2013 NO 20130928
16.09.2013 NO 20131242

(43) Date of publication of application:
16.12.2015 Bulletin 2015/51

(73) Proprietor: **MacGregor Norway AS**
4841 Arendal (NO)

(72) Inventors:
• **ALBRIGTSEN, Rolf**
N-4879 Grimstad (NO)
• **HØVIK, Jon**
N-4818 Færvik (NO)

(74) Representative: **Onsagers AS**
P.O. Box 1813 Vika
0123 Oslo (NO)

(56) References cited:
WO-A1-2007/113203 WO-A1-2010/137990
FR-A1- 2 941 434 US-A- 3 199 553

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EP 2 953 847 B1

Description

[0001] The invention concerns an arrangement and methods for connection and disconnection of at least one hose carrying fluid especially LNG and/or vaporized LNG.

[0002] The fluid to be transferred by the invention, may be any kind of fluid, and may be employed for the transfer of hydrocarbons, including the transfer of LNG, and vaporized LNG, LPG and other fluid in gaseous and liquid form. In one application the invention may be used for transferring fluid such as LNG from a floating LNG production facility (FLNG) to an LNG carrier, and the transfer system may comprise three separate hose lines, two dedicated for the transfer of LNG to the LNG carrier and one for the return of vaporized LNG to the FLNG.

[0003] The transfer of fluid in between two structures, is a demanding and risky operation. Especially when the transfer is carried out in the open sea, and when the fluid is both a cryogenic fluid and a hydrocarbon which is highly flammable and explosive, the transfer operation is especially risky and special care needs to be taken.

[0004] As mentioned above the fluid may be transferred between structures where both are located in water. Alternatively the fluid transfer may occur between structures where one of these is located in water and the other one is a land based structure. The structures located in water may comprise different kind of vessels, barges, ships and platforms or other structures suitable for loading or offloading. The structures or vessels may be floating, submersible, semisubmersible or resting on the seabed. Various systems may be employed for holding the structures in position, for instance mooring arrangements such as a turret system, anchor positioning or a dynamic positioning system may be used. Prior art solutions for transfer of fluid between structures include the arrangement of a tandem position, stern offloading or a side by side configuration.

[0005] Various rigid systems for the transfer of fluid in between structures have been proposed using fixed arms and rigid articulated pipes. The rigid systems are relatively complex and heavy, and high loads are working on systems when wave motions cause the structures to move relative to each other.

[0006] Prior art solutions include the systems disclosed in WO 2010137990, US 2914080, WO 2007113203, GB 900877, US 2818891, US 2914080, US 2922446, US 3228421 and "The All Metal LNG Offloading System for the Adriatic LNG Terminal" by Charles Hughes and Renaud Le Devehat presented at the Gastech conference, Abu Dhabi 2006.

[0007] As an alternative to the rigid pipe system for transfer of fluid, the use of flexible hoses have been suggested. However, the flexible lines are more cumbersome to handle during connection to a manifold on a receiving structure, and prior art systems have not presented satisfactory solutions for the control of the flexible hoses when connection is carried out in open sea.

[0008] When one of the structures or both, involved in the transfer of fluid is located in water it is a concern to provide a solution which is capable of handling the movements occurring due to wave movements. Further, even if the invention should be able to handle the transfer of all kind of fluid, the wish to also be able to transfer LNG, challenges the functional features as the transfer of LNG involves high risk operations due to the special concern which needs to be shown when handling cryogenic fluid.

[0009] Due to the high risk when transferring LNG and the strict safety restrictions needed to apply to these systems, one certified solution for transfer of LNG satisfying these restrictions has been favorable in the market.

[0010] This solution is a rigid loading arm which is positioned on a first structure for instance a FLNG, for connection to a manifold structure on a second structure for instance a LNG carrier. The arm is balanced by a counter weight and makes use of rigid pipes for the transfer of fluid from one structure to the other. The system also employs a swivel system to be able to compensate for relative movement between the two structures. The large masses of the system made of rigid pipes and heavy counterweight may in some situations result in high dynamic forces and considerable impact on the manifold as a function of the relative movements between the structures. This may occur during connection to the second structure, and also during use when the system is installed and the fluid is transferred from one structure to the other. The manifolds on the LNG carrier are especially vulnerable in these given circumstances. And the resulting forces working on the system set requirements to the wave height and thus restrictions to when the loading arm may be used for transfer of fluid.

[0011] A need has evoked within the technical field to provide solutions which do not have the drawbacks of the current solutions. It is a critical factor for the operators to be able to transfer fluid also outside the conservative weather window of the above mentioned rigid loading arm.

[0012] Hence it is an object of the invention to provide an arrangement, which has features enabling the use of the system also without the drawback of the conservative wave restrictions applying to the rigid loading arms mentioned above. It is further an object of the invention to produce an arrangement with low active dynamic masses where the load impact working in the connections is low. It is further also an object to provide a system wherein the compensation of the relative movements between the two structures is handled in a more simplified way. A further object is to provide a solution to carry out the connection to the receiving assembly such as a manifold on a structure, for instance the LNG carrier, without exposing the manifold to large forces, even when the waves are heavy.

[0013] In one application the invention is to be used in a situation where the transfer of fluid occurs between two structures which are arranged side by side.

[0014] The invention is defined in the independent

claims and the embodiments of the invention are defined in the dependent claims.

[0015] The invention comprises an arrangement according to claim 1 and methods according to claims 19 and 20.

[0016] Thus the invention comprises arrangement for connection of at least one hose carrying fluid especially LNG and/or vaporized LNG, wherein a hose end of the at least one hose has a hose end connector to be connected to a receiving assembly on a first structure located in water. The hose end connector is provided with guide means and the receiving assembly is provided with receiving means. Further, the arrangement includes handling means for controlling the hose end connector to position the guide means into the receiving means and to accommodate the guide means in the receiving means so that the guide means is supported in the receiving means and the weight of the hose end connector is transferred to the receiving means. The hose end connector is then brought into a connecting position with a receiving pipe coupling in the receiving assembly such as receiving pipe stud coupling. In the receiving assembly a receiving pipe coupling is provided one for each hose end connector. If three hoses are included in the arrangement, the hose end connector of each hose fits with a corresponding receiving pipe coupling in the receiving assembly. In the connecting position the hose end connector may be locked to the corresponding receiving pipe coupling by suitable locking means.

[0017] The invention also include a method for connection of at least one hose carrying fluid especially LNG and/or vaporized LNG, wherein a hose end of the at least one hose has a hose end connector to be connected to be a receiving assembly on a first structure located in water. The hose end is provided with guide means and the receiving assembly is provided with receiving means, wherein handling means is provided for controlling the hose end connector and positioning the guide means relative to the receiving assembly, wherein the method includes the following steps:

positioning the guide means to be accommodated in the receiving means,

- accommodating the guide means in the receiving means,
- transferring the weight of the hose end connector to the receiving means,
- moving the hose end connector into a connecting position with a receiving pipe coupling.

[0018] The guide means may be arranged so that it is easily fitted into the receiving means. When the guide means is arranged in the accommodated position in the receiving means, an axial axis of the elongated formed guide means may be oriented in parallel with an axial axis of the receiving means.

[0019] The guide means and or the receiving means

may have features enabling the guide means to pivot in the receiving means. In one aspect the guide means may be configured as an elongated member, and the guide means may then be provided with plural hose end connectors spaced side by side along the guide means. At least some parts of its cross section are configured with a circular shape to be able to pivot in the receiving means.

[0020] In one embodiment the receiving means may be shaped as a cradle or a cradle shaped structure fitted for receiving the guide means. In accordance with this aspect, the elongated formed guide means fits easily into the cradle shaped receiving means. By this arrangement of the guide means and the receiving means, the insert of the guide means into the receiving means is easy to carry out and the fitting need not be as accurate as prior art targeting solutions where the end of a pipe like element is to be inserted into a corresponding aligning cone. As the skilled person will realize, the receiving means may have a configuration other than a cradle shaped structure.

[0021] The parts of the guide means which are configured for pivoting may be enlarged compared to the overall cross section of the elongated member. In an alternative solution the receiving means may be provided with features which enable the pivoting of the guide means. In one embodiment the receiving means may be shaped as a cradle fitted for receiving the guide means. As a further aspect of this embodiment the guide means may be arranged so that it is easily fitted into the receiving means, and in one aspect the guide means may be configured as an elongated member. With the guide means formed as an elongated member, plural hose end connectors may be spaced side by side along the guide means. In accordance with this aspect, the elongated formed guide means fits easily into the cradle shaped receiving means, and the in the accommodated position in the receiving means, an axial axis of the elongated formed guide means is oriented in parallel with the an axial axis of the receiving means. By this arrangement of the guide means and the receiving means, the insert of the guide means into the receiving means is easy to carry out and the fitting need not be as accurate as prior art targeting solutions where the end of a pipe like element is to be inserted into a corresponding aligning cone.

[0022] In accordance with the arrangement as defined above, the weight of the hose end connector is transferred to the receiving means from the handling means. The handling means is provided for controlling and directing the guide means correctly into the receiving means before transferring the weight from the handling means to the receiving means, and thus the handling means carries the weight of the hose end connector before accommodating the guide means in the receiving means.

[0023] In accordance with one embodiment of the arrangement as defined above, a hose guide and support structure on the first structure is provided for supporting the hose end and carrying a portion of the weight of the

hose end and hose end connector when the hose end connector is connected to the receiving assembly.

[0024] In accordance with the inventive connection arrangement the hose end connector is to be connected to the receiving assembly on a structure located in water. The other end of the hose may be connected or adapted for connection to a connection point on another structure, such as a FLNG. The weight of this hose arrangement is comparatively lower than the weight of the prior art rigid loading arm solution as described earlier, and the forces working in the receiving assembly such as the manifold is thus reduced when connecting a hose. Further using a hose arrangement makes for a solution where there is no need for swivels at all, and this makes a simplified solution compared to the rigid loading arm solution.

[0025] According to the invention the receiving means are located above the receiving pipe coupling of the receiving assembly. When positioning the guide means into the receiving means, the guide means is arranged to pivot in the receiving means with the hose end connector making a pivoting movement, when bringing the hose end connector into the connecting position with the receiving pipe coupling.

[0026] To achieve the pivoting of the guide means in the receiving means, the guide means or the receiving means or both, may be shaped so that the guide means or the receiving means in contact with each other provide for the pivoting of the guide means. In one aspect the guide means may be provided with appointed areas designated for the pivoting of the guide means, or the whole embodiment of the guide means may be shaped for instance with a circular cross section, so that the guide means is able to pivot in the receiving means. Alternatively, additional means may be provided to be able to conduct the pivoting of the guide means.

[0027] To avoid clashing and collateral damage when bringing the hose end connector into a connecting position with the receiving pipe coupling, landing and dampening means may be provided for controlling the pivoting movement of the hose end connector into the connecting position with the receiving pipe coupling. The landing and dampening means may be provided as fluidly operated means or as a mechanical device, or as a combination of these two.

[0028] When obtaining connection between the hose end connector and the receiving assembly, the relative movement between the hose end connector and the receiving assembly on the structure located in water, may cause considerable contact forces when establishing the contact between the parts of the hose end connector and the receiving assembly. Consequently, it may be favourable that the arrangement in accordance with the invention, in one embodiment is provided for controlling the hose end connector for accommodation of the guide means into the receiving means in accordance with the movement of the structure.

[0029] The handling means for controlling hose end

connector comprises lifting and lowering means for controlling the hose end connector. The lifting and lowering means may be provided by various arrangements such as a solid structure capable of maneuvering the hose end connector into the receiving assembly. In an alternative aspect, the handling means comprises lifting and lowering means as a line arrangement with lifting and lowering devices for paying out and retrieving lines connected to the hose end connector and thus manipulating the position of the hose end connector. In one aspect the lifting and lowering means comprise a hose end guiding line and a hose end suspension line both connected to the hose end connector. In accordance with this embodiment the hose end suspension line may carry the weight of the hose end connector and the lifting and lowering devices control the hose end suspension line by paying out or retrieving the hose end suspension line and thereby controlling the position of the hose end connector. The lifting and lowering devices pays out or retrieve the hose end guiding line for instance for attaching the hose end guide line to the receiving assembly. The hose end guiding line is arranged for guiding the hose end connector to the receiving assembly.

[0030] The lifting and lowering devices may have an operation mode allowing for paying out line. Thus the lifting and lowering devices may be provided with locking means or a locking position, preventing the pay out of line.

[0031] The hose end guide line may be arranged sliding through a suitable device for instance a passage formed in the hose end connector so that the hose end connector is able to move relative to the hose end guide line. In one embodiment the hose end guiding line and hose end suspension line are suspended in a support structure and controlled by lifting and lowering devices, as explained above. The hose end guiding line is to be attached at the receiving assembly and the pay out and retrieval of the hose end guiding line is controlled by the lifting and lowering devices. The positioning of the hose end connector is controlled by lowering the hose end suspension line moving the hose end connector along the hose end guiding line.

[0032] It may be favorable for the safe lowering of the hose end connector that the hose end guiding line is to be held in a tensioned state. For the provision of the tensioned hose end guiding line it may be necessary to compensate for relative movement of the structure or between the structures. In one embodiment this is done by paying out and retrieving the hose end guiding line using the lifting and lowering devices in accordance with the wave movements.

[0033] To minimize the impact of contact forces when the guide means is accommodated in the receiving means, it is desirable to time and coordinate the positioning and accommodation of the guide means into the receiving means. The paying out and retrieval of the hose end guiding line by the lifting and lowering device may be used as a reference or reflection of the wave motions to decide the timing for accommodating the guide means

in the receiving means. One way to provide a realistic image of the wave motions is to provide sensors to register the paying out and retrieval of the hose end guiding line.

[0034] By this aspect of the arrangement the positioning and accommodation of the guide means in the receiving means is controlled by the hose end guide line and the hose end suspension line.

[0035] In accordance with the inventive method for connection at least one hose end connector of a hose carrying fluid especially LNG and/or vaporized LNG to a receiving assembly as mentioned above, the handling means in one embodiment comprise the hose end suspension line arranged with the belonging lifting and lowering devices, wherein the hose end suspension line is suspended in the support structure and connected to the hose end connector. In accordance with this embodiment the hose end guiding line is suspended by the support structure and connected to the hose end and may be arranged with belonging lifting and lowering devices and, for the positioning and accommodation of the guide means in the receiving means, the following steps are conducted:

Attaching the hose end guiding line to the receiving assembly, and thereby establishing a guidance for the hose end connector which is to be moved along the hose end guiding line, when lowering the hose end suspension line for positioning and accommodating the guide means in the receiving means as explained above.

When the guide means is accommodated in the receiving means the hose end suspension line is lowered further moving the hose end connector into a connecting position with the receiving pipe coupling. The hose end connector is brought into the connecting position preferably by pivoting the guide means in the receiving means and bringing the hose end connector into the connecting position by a pivoting movement.

[0036] In one embodiment the weight of the hose end connector causes the lowering of the hose end connector along the hose end guiding line. The lowering may also be conducted otherwise, such as by bringing a winch into an operation mode and lowering the hose end connector independent of the weight of the hose end connector.

[0037] In an aspect where a counterweight is included in the lifting and lowering device, the hose end suspension line may be suspended in a support structure so that the counterweight and the hose end connector are positioned in a counterbalancing relationship. In a further aspect the weight of the hose end connector may be larger than the counterweight and when an operation mode is chosen for paying out the hose suspension line this causes the lowering of the hose end connector along the hose end guiding line.

[0038] In one embodiment of the arrangement, landing

and dampening means is provided for controlling the pivoting movement of the hose end connector into the connecting position with the receiving pipe coupling. By controlling the movement of the hose end connector by the use of landing and dampening means, the impact force of the hose end connector when being moved into a connecting position with the receiving pipe coupling, is considerably reduced.

[0039] The arrangement may also include means ensuring that the hose end connector is positioned correctly to fit with the corresponding receiving pipe coupling in the connecting position and also when the locking between the hose end connector and the receiving pipe coupling takes place. The hose end connector is to be connected to various receiving arrangement, and as the receiving arrangement may vary from one receiving arrangement to another, it is especially useful to provide the arrangement so that the hose end connector can be fitted to match with the specific receiving arrangement.

[0040] In one embodiment of the arrangement, the hose end connector and the receiving pipe coupling is provided with adjustment means to obtain a first correction of the positioning of the hose end connector to fit in alignment with the corresponding receiving pipe coupling in the connecting position. For the correct positioning of the hose end connector relative to the corresponding receiving pipe coupling, the adjustment means may have a flexibility for adjustment of the hose end connector along three axis ensuring that the hose end connector is positioned correctly during the pivoting movement which takes place when bringing the hose end connector into connecting position with the receiving pipe coupling. The guide means of the hose end connector may be arranged in an elevated position above the hose end connector by the arrangement of a distance member.

[0041] To obtain the flexibility of the adjustment means, the adjustment means may comprise a joint allowing for the controlled displacement of the hose end connector relative to the guide means. The joint may comprise a first joint part in attachment with the hose end connector and a second joint part in attachment with the guide means. The first joint part and the second joint part are provided as separate structures or are made as a part of the existing construction. The first joint part and the second joint are joined together by adjustment elements for instance a flexible element or adjustment screws making up a flexible joint, which is arranged so that a three axis displacement may be carried out for the hose end connector relative to the guide means to fit with the receiving pipe coupling. In one embodiment the distance member may be divided into two parts, wherein each of the joint parts is connected to each of the distance member parts.

[0042] Alternatively the adjustment means may comprise grooves, mechanical positioning alignment screws or guide plates provided at receiving pipe coupling.

[0043] In one embodiment the arrangement is provided with alignment means for additional correction of the position of the hose end connector to fit in alignment with

the corresponding receiving pipe coupling. The alignment of the hose end connector relative to the receiving pipe coupling provides a tight connection when locking the hose end connector to the receiving pipe coupling by suitable locking means. The alignment means may comprise interacting alignment devices such as a first alignment device, for instance a conical shaped guiding pin which is included in the receiving assembly, and a second alignment device for instance a conical recess formed in the hose end connector. When the hose end connector approaches the receiving pipe coupling to be connected, the first and the second alignment devices are placed into an interacting position, and in the example as mentioned above this means that the conical shaped pin is accommodated in the conical shaped recess. Consequently, the alignment means positions the hose end connector to fit with the corresponding receiving pipe coupling in the connecting position. When the connection between the hose end connector and the receiving pipe coupling occurs by a pivoting movement as mentioned above, the alignment means correct the position of the hose end connector during the pivoting movement.

[0044] In one embodiment the alignment means, for instance the first alignment device may include landing and dampening means for controlling the movement of the hose end connector into the connecting position with the receiving pipe coupling.

[0045] In one embodiment locking means such as hydraulic activated claws may be provided for locking the hose end connector to the receiving pipe coupling in the connecting position.

[0046] As explained above, the adjustment means and the alignment means are provided to position the hose end connector in alignment with the receiving pipe coupling. In addition some parts of the receiving arrangements for instance the receiving means and/or the receiving pipe coupling may be arranged so that it may be adjusted to fit with hose end connector.

[0047] When plural hose end connectors are included in the arrangement, it may be desirable to first adjust the receiving arrangement for instance by adjusting the position of the receiving means or the receiving pipe coupling so that the pivot axis of the guide means is positioned suitable so that the pivoting movement to be carried out by the hose end connector brings the plural hose end connectors into connection position with the corresponding receiving pipe coupling. The individual hose end connector will thereafter be adjusted by the adjustment means and the alignment means, to fit correctly with the corresponding receiving pipe coupling as described above.

[0048] The arrangement in accordance with the invention is suitable for connection of the hose end connector to a receiving assembly, but will of course also be suitable for the disconnection of the hose end connector from the receiving assembly. During the disconnection procedure, the hose end connector which is connected to the receiving pipe coupling in the receiving assembly is first dis-

connected from the receiving pipe coupling and moved into a disconnecting position away from the receiving pipe coupling. In this situation the guide means is still accommodated in the receiving means and the disconnecting movement is favorably carried out by pivoting the guide means in the receiving means and removing the hose end connector from the connected position by a pivoting movement. The guide means is then relieved from an accommodated position in the receiving means, thereby transferring the weight of the hose end connector from the receiving means to the handling means, and then moving the hose end connector away from receiving assembly.

[0049] The handling means control the position of the hose end connector and thus control moving the hose end connector from the connecting position to the disconnection position. When the handling means comprises a hose end suspension line and a hose end guiding line, the hose end suspension line is lifted by the lifting and lowering devices, thereby moving the hose end connector away from the receiving pipe coupling into the disconnecting position. When relieving the guide means from the receiving means the weight of the hose end connector is transferred from the receiving means to the hose end suspension line. The further lifting of the hose end suspension line moves the hose end connector away from the receiving assembly, and the hose end connector is guided along the hose end guiding line.

[0050] The invention also includes a receiving assembly for connection of at least one hose end connector of the hose carrying fluid especially LNG and/or vaporized LNG. In addition to the receiving assembly being provided with receiving means adaptable for accommodation of the guide means, the receiving assembly is also arranged with a receiving pipe coupling provided with adaptation means for fitting the at least one receiving pipe coupling with a specific hose end connector. The adaptation means comprise an interface element with a configuration adaptable to preset the interface element to fit with the specific dimension/outlay of each hose end connector that has an interface element with an adaptable configuration so that hose end connectors with various outlays may fit in connection with the corresponding receiving pipe coupling. The interface element has a configuration which is adaptable to preset the interface element to fit with the specific dimension/outlay of the hose end connector. The interface element may be provided with a high degree of position accuracy.

[0051] An example of an embodiment of the invention will now be described in the following with reference to the figs, wherein

Figs 1a-1d show side views of an example of an installation of a hose end connector to a structure located in water.

Figs 2a -2d show the installation of a hose end connector as shown in figs 1a-1d, but here shown with landing and dampening means in accordance with

a first embodiment.

Figs 3a-3d show a second embodiment of the dampening means.

Figs 3e-3i show a third embodiment of the landing and dampening means.

Figs 4a-4g show a sequence for attaching a line arrangement to a structure.

Figs 5a-5b show an embodiment of the inventive arrangement provided with means for connection of the hose end connector to the pipe on a structure located in water.

[0052] Figs 1a-1d show an arrangement for connection of at least one hose end connector 91 to a receiving assembly 90 on a first structure 80 located in water such as an LNG carrier. The hose end connector 91 is arranged at a hose end 63 of a hose carrying fluid especially LNG and/or vaporized LNG. The hose end connector 91 has guide means 102, arranged elevated from the hose end connector 91 by a distance member 94. The receiving assembly 90 has a connection area, in the figs 1a-1d shown as a receiving coupling pipe 15 attached to a pipe 16. The receiving assembly 90 also includes receiving means 71, here shown as a cradle. Additional locking means for securing the guide means 102 in the receiving means 71 may be provided. The receiving means 71 is located above the receiving coupling pipe 15. The position of the hose end connector 91 is controlled by suitable handling means (not shown). The handling means may comprise lifting and lowering means such as for instance a line arrangement provided with lifting and lowering devices. An example of lifting and lowering means for controlling the hose end connector 91 is shown in fig 4a-4g. In the embodiment shown in figs 1a-1e, the hose end connector 91 comprises a hose end connector valve 13 and a hose end coupler valve 14 for controlling the flow of fluid through the hose end connector 91.

[0053] A hose guide and support structure 300 is located on the first structure 80 and is configured for supporting the hose end 63, when the hose end connector 91 is connected to the receiving assembly 90. The hose guide and support structure 300 is provided so that the receiving assembly 90 is relieved of at least some of the load provided by portions of the hose end 63 and the hose end connector 91. In addition to the load relieving purpose, the hose guide and support structure 300 also has a bending restriction function. The support structure 300 has a bending restriction part 302 with a curvature providing the hose end 63 with a curve to avoid damage on the hose. The structure 301 as shown in the figures is a fence.

[0054] In fig 1a, the handling means has positioned the guide means 102 just above the receiving means 71 preparing the guide means 102 to be guided into the receiving means 71. In this position the weight of the hose end connector 91 is carried by the handling means.

[0055] Fig 1b shows a situation where the guide means 102 has been lowered into accommodation in the receiv-

ing means 71, by the use of the handling means. With guide means 102 supported in the receiving means, the weight of the hose end connector 91 is transferred from the handling means to the receiving means 71. The guide means 102 may be secured in the receiving means 71 by the additional locking means.

[0056] As seen in fig 1a and 1b, the shape of the receiving means here shown as a cradle and the lowering of the guide means into the open shape of the receiving means provides an interacting arrangement where it is fairly simple to position the guide means correctly into the receiving means.

[0057] Fig 1c and 1d, show the steps for bringing the hose end connector 91 into a connecting position with the receiving coupling pipe 15 in the receiving arrangement 90. When bringing the hose end connector 91 into this connecting position, the guide means is arranged to pivot in the receiving means 71 with the hose end connector 91 making a pivoting movement. The hose end connector 91 is brought into a connecting position with the receiving coupling pipe 15 and the hose end 63 is accommodated in the guide and the support structure 300. In this position the guide and the support structure 300 carries a portion of the load of the hose end 63 and the hose end connector 91.

[0058] The guide means 102 and or the receiving means 71 have features enabling the guide means 102 to pivot in the receiving means 71. In one aspect the guide means 102 may be configured as an elongated member where at least some parts of its cross section is configured with a circular shape to be able to pivot in the receiving means 71. These parts which are configured for pivoting may be enlarged compared to the overall cross section of the elongated member. In an alternative solution the receiving means 71 may be provided with features which enable the pivoting of the guide means. Fig 1d shows the hose end 63 accommodated in the hose end support structure 300 and the hose end connector 91 in connecting position and ready for locking to the belonging receiving coupling pipe 15 of the receiving assembly 90, for instance by engaging coupler claws.

[0059] In the case where the arrangement includes plural hoses to be connected to the first structure located in water such as the shown LNG carrier, the hose end connectors belonging to the respective hose may be arranged side by side along the guide means so that the connection to the receiving assembly can be carried out almost simultaneously. The installation will follow the same procedure as when installing one hose end connector.

[0060] Figs 2a-2d show the hose end connector 91 arranged with a first embodiment of landing and dampening means for bringing the hose end connector 91 into a connecting position with the receiving coupling pipe 15 in a controlled manner. The dampening means is shown as at least one cylinder and piston unit 120 comprising a cylinder 124 and a piston rod 121 with one end accommodated inside the cylinder 124 and the other end pro-

jecting from the cylinder 124 and provided with a wheel 122. In the situation in fig 2a the piston rod 121 have maximum stroke out from the cylinder 124. The cylinder space inside the cylinder is filled with a fluid preloading the cylinder rod and thereby providing a resistance against moving the piston rod back into the cylinder

[0061] The cylinder unit 120 is positioned below the hose end connector 91 and attached to the hose end connector 91 by a hinge arrangement allowing for a restricted hinging movement of the cylinder unit 120. In this position the piston rod points in the direction of the receiving assembly 90 and the wheel 122 is to be inserted in a recess 123a which is positioned below the receiving coupling pipe 15. The hose end connector 91 is connected to the receiving arrangement following the steps as explained above and shown in fig 1a-1d. As seen in fig 2b the piston rod 121 with the wheel 122 is inserted into the recess 123a when the guide means 102 is accommodated in the receiving means 71. When the guide means 102 pivots in the receiving means 71 and the hose end connector 91 makes a pivoting movement to bring the hose end connector 91 into a connecting position with the receiving coupling pipe, 15, the wheel 122 travels in the recess 123a until reaching an end stop 126, as shown in fig 2c. When conducting the further pivoting movement for bringing the hose end connector 91 into connecting position with the receiving coupling pipe 15, the resistance against moving the piston rod 121 back into the cylinder is exceeded and the pivoting movement is conducted in a controlled manner, thereby providing dampening effect to the connection between the hose end connector 91 and the receiving coupling pipe 15.

[0062] Fig 3a-3d show a second embodiment of the landing and dampening means with features as shown in fig 2a-2d, but in this embodiment two cylinder units 120 are included, each having a piston rod 121 with a wheel 122. The arrangement differs from the arrangement in fig 2a-2d in that the cylinder units 120 are positioned in a vertical direction. A recess 123b is provided for each of the piston rods 121 and these recesses 123b are positioned in a distance away from the receiving arrangement. However, the working principle of the cylinder unit 120 and the interaction between the piston end with the wheel 122 inserted in the recess 123 are the same as explained above with reference to fig 2a-2d.

[0063] Fig 3e-3i show a third embodiment of the landing and dampening means. The landing and dampening means comprises a frame structure 403 holding a cylinder unit 120 made up by a cylinder 124 with a piston rod 121, wherein this cylinder unit has the same working principles as the cylinder units 120 as described in fig 2a-2d and fig 3a-3d. However, in accordance with this third embodiment of the landing and dampening means, a wheel 122 is included in a wheel unit 400 which is pivotally connected to the piston rod 121 with a first pivot 402. The wheel unit 400 further has a second pivot 401 pivotally connecting the wheel unit to the frame structure 403. A spring 404 is included in the wheel unit 400 to provide

additional dampening when the wheel 122 makes contact with the hose support structure 300. The landing and dampening means has an attachment point 407 for the connection of the suspension line 27 (not shown)

[0064] As shown in fig 3e-3g the piston rod 121 is extended from the cylinder 124. With this position of the piston rod, the wheel unit 400 is prepared for contact with the hose support structure 300, and as the guide means 102 is accommodated and pivots in the receiving means 71, the wheel 122 arrives in contact with the hose support structure 300 as shown in fig 3g. In this position an inspection and wipe off of the contact surfaces 405, 406 to form the connection between the receiving assembly 90 and the receiving pipe coupling 15, may be carried out.

[0065] This same position for inspection and wiping off of the contact surfaces 405, 406 is shown for the first and second embodiment in fig 2b and 3b, where the wheel 122 arrives in contact with the recess 123a, 123b as shown in fig 2b and 3b, as the guide means 102 is accommodated and pivots in the receiving means 71.

[0066] When the contact has been made between the wheel 122 and the hose support structure 300 as shown in fig 3g, the cylinder unit 120 then starts retracting the piston rod 121 into the cylinder 124. The wheel unit 400 is thereby folded and the hose end 63 is brought in supportive contact with the hose support structure 300 as the hose end connector 91 is brought into connecting position with the receiving assembly 9, as shown in fig 3i.

[0067] Figs 4a-4g show the installation of the hose end connector 91 into the receiving assembly 90 by the use of handling means such as lowering and lifting means comprising a line arrangement and belonging lowering and lifting devices. The installation of the hose end connector 91 is carried out by the use of a support structure 200 here shown as a vertical structure 1 which is arranged with one arm 106 oriented in a transverse direction. In the installation situation as shown in figs 4a-4g, the support structure 200 is located on a FLNG 70 and the hose end connector 91 is to be connected into a receiving assembly 90 located on a first structure 80 located in water, such as a LNG carrier. Alternatively the support structure 200 may be located on any other structure relevant for the task to be carried out.

[0068] For the installation of the hose end connector 91, the line arrangement comprises a hose end guiding line 35 connected to the hose end connector 91. The hose end guiding line 35 is provided with lifting and lowering devices such as a winch 33 for paying out and retrieving the hose end guiding line 35 and thereby controlling the position of the hose end connector 91. The hose end guiding line 35 is suspended by the support structure 200 and is shown arranged on the arm 106 of the support structure 200 by means of sheaves 38, 34.

[0069] The arrangement also includes a hose end suspension line 27 which is also connected to the hose end connector 91. The hose end suspension line 27 is attached to the support structure 200 by means of sheaves 28, 31 and provided with lifting and lowering devices such

as a counter weight 22 and a winch 24 for paying out and retrieving the hose end connector suspension line 27. The counterweight 22 is arranged to be displaced in a counterweight guiding path 21 as shown in the figs 4a - 4g. The weight of the hose end connector 91 and the hose end connector 91 is larger than the counterweight 22, and consequently the counterweight 22 is displaced in an end stop position at end stops 25. When the counterweight 22 is positioned in this end stop position, the paying out and retrieval of the hose end suspension line 27 is carried out by the winch 24. As an alternative to the combination of the winch 33 and the counter weight 22 as shown in the figs 4a-4g, the lifting and lowering means may comprise solely a winch 22.

[0070] The guide means 102 of the hose end 63 is arranged in an elevated position above the hose end connector 91, by the distance member 94, as earlier explained and shown in fig 1a-1d. The receiving means 71 for receiving the guide means 102 is shown in figs 4a-4g as a cradle and is arranged elevated above the pipe 16.

[0071] When installing the hose end connector 91 in accordance with the embodiment shown in figs 4a-4g, the hose end guiding line 35 is to be attached to an attachment point provided at the receiving assembly 90. The attachment point may be a hole or a recess for instance with a key hole shaped opening holding the hose end guiding line 35 in position with the weight 107 acting as locking means against the key hole (this is not shown in the figs). As illustrated in fig 4a and 4b the hose end connector guiding line 35 is lowered to the LNG carrier by the use of a messenger line 93. The hose end guiding line 35 has a weight 107 arranged at its end, and when the weight 107 is in a position approximately at the hose end connector 91, the hose end connector 91 is held in an essentially leveled position. When the winch 33 is brought into an operation mode where the hose end guiding line 35 is allowed to pay out due to the weight 107, the hose end guiding line 35 with the weight 107 is lowered down to the LNG carrier 70. The hose end suspension line 27 then carries the weight of the hose end 63 and the hose end connector 91. With the weight 107 away from the hose end connector 91 and the paying out of the hose end guiding line 35 over the sheave 38, the hose end connector 91 is allowed to be tilted downwards in direction of the receiving assembly 90, see fig 4b. Thus the tilting of the hose end connector 91 is controlled by the weight balance of hose end 63 and hose end connector 91 towards the suspension point of line 27.

[0072] Fig 4c shows the arrival of the weight 107 and the hose end guiding line 35 on the first structure 80. The weight 107 is positioned in a temporary storage on the LNG carrier, see fig 4c. The winch 33 pays out a sufficient amount of the hose end guiding line 35 as illustrated by arrow A, making sure that the hose end guiding line 35 is arranged in a slack manner on the deck of the LNG carrier. The hose end guiding line 35 is then ready to be connected to the receiving assembly 90, in order to make a safe attachment to the receiving assembly 90 as shown

in fig 4d, without transferring the movements from the FLNG to the LNG carrier.

[0073] After the attachment of the hose end guiding line 35 to the receiving assembly 90, the winch 33 starts to retrieve the hose end guiding line 35 as shown in fig 4e, and the hose end guiding line 35 is payed out and retrieved, as illustrated by arrow AB in accordance to the relative movements between the LNG carrier and the FLNG. This enables the hose end guiding line 35 to be arranged in a stretched or tensioned manner in order to guide the hose end connector 91 along the hose end guiding line to connection with the receiving assembly 90 on the LNG carrier.

[0074] When the hose end guiding line 35 is brought into the tensioned manner as shown in fig 4f, the winch 24 is also brought into an operation mode manner of pay-out and retrieval and automatic compensation for the relative movements between the LNG carrier and the FLNG. The counterweight 22 is then lowered into an intermediate position in the guiding path 21. Hence the counterweight 22 is then keeping the suspension line 27 in a constant tension state and by weight balance regulating for the relative movements between the LNG carrier and the FLNG.

[0075] When disconnecting the hose end connector 91 from the receiving assembly 90, a procedure following the steps for installation of the hose end connector, but carried out in a reverse order.

[0076] Fig 5a shows the inventive arrangement provided with means for adjusting to fit the hose end connector 91 relative to the receiving pipe coupling 15. In the situation in fig 5a, the guide means 102 is accommodated in the receiving means 71. The receiving assembly 90 may be provided by means for positioning of the receiving means 71. Fig 5b show the hose connector 91 in a connecting position with the receiving pipe coupling 15. Adjustment means 160 is provided to correct the position of the hose end connector 91 to fit with the corresponding receiving pipe coupling 15 in the connecting position. The adjustment means 160 is arranged so that the hose end connector 91 can be adjusted along three axis III, which are oriented perpendicular relative each other as illustrated in the fig 5a. By adjusting the hose end connector 91 along these three axis, the hose end connector 91 is positioned to fit with the receiving pipe coupling 15. The adjustment means 160 is shown included in the distance element 94, here shown as a two part element.

[0077] Suitable locking means 157, here shown as locking claws to engage with the receiving pipe coupling 15, is provided to lock the hose end connector 91 to the receiving pipe coupling 15, as shown in fig 5b. The arrangement is shown arranged with alignment means to position the hose end connector 91 correctly relative to the receiving pipe coupling 15 to obtain a sealing when carrying out the locking. The alignment means is shown in fig 5a as a first alignment device 150 in the form of conical shaped guiding pins arranged in the receiving assembly 90. Second alignment device 151 here shown

as conical recesses is formed in the hose end connector 91. When the hose end connector 91 is pivoted into the connecting position with the belonging receiving pipe coupling 15, the first alignment device 150 is inserted into the second alignment device 151, thereby seeking to align the hose end connector 91 with the receiving pipe coupling 15, see fig 5b.

Claims

1. Arrangement for connection of at least one hose carrying fluid especially LNG and/or vaporized LNG, said arrangement comprises said hose, a hose end connector (91), a receiving assembly (90) and a first structure (80) located in water wherein a hose end (63) of the at least one hose has a hose end connector (91) which is to be connected to said receiving assembly (90) on said first structure (80) located in water, wherein the hose end connector (91) is provided with guide means (102) and the receiving assembly (90) is provided with receiving means (71), wherein the arrangement includes handling means for controlling the hose end connector (91) to position the guide means (102) into the receiving means (71) and accommodate the guide means (102) in the receiving means (71) so that the guide means (102) is supported in the receiving means (71), **characterized in that** the weight of the hose end connector (91) is adapted to be transferred to the receiving means (71), **in that** the hose end connector (91) is configured to take a connecting position with a receiving pipe coupling (15) in the receiving assembly (90), with one receiving pipe coupling (15) provided for each hose end connector (91) **in that** the receiving means (71) is located above the receiving pipe coupling (15) of the receiving assembly (90), providing for the guide means (102) to pivot in the receiving means (71) with the hose end connector (91) making a pivoting movement, when bringing the hose end connector (91) into the connecting position with the receiving pipe coupling (15), **in that** the handling means comprises lifting and lowering means which comprises a hose end guiding line (35) and a hose end suspension line (27) both connected to the hose end connector (91), which hose end guiding line (35) and hose end suspension line (27) are suspended from a support structure (200) and controlled by lifting and lowering devices, **in that** the hose end guiding line (35) is configured to be attached to the receiving assembly (90) **in that** the positioning of the hose end connector (91) is controlled by lowering the hose end suspension line (27) thereby moving the hose end connector (91) along the hose end guiding line (35).
2. Arrangement for connection of at least one hose in accordance with claim 1, **characterized**

in that the weight of the hose end connector (91) is transferred to the receiving means (71) from the handling means.

3. Arrangement for connection of at least one hose in accordance with claim 1 or 2, **characterized in that** it is adapted for controlling the hose end connector (91) for accommodating the guide means (102) into the receiving means (71) in accordance with the movement of the first structure (80).
4. Arrangement for connection of at least one hose in accordance with one of the preceding claims, **characterized in that** the receiving means (71) is shaped as a cradle fitted for receiving the guiding means (102).
5. Arrangement for connection of at least one hose in accordance with one of the preceding claims, **characterized in that** a hose guide and support structure (300) is provided on the first structure (80) for supporting the hose end (63) and carrying a portion of the weight of the hose end (63) and the hose end connector (91), when the hose end connector (91) is connected to the receiving assembly (90).
6. Arrangement for connection of at least one hose in accordance with one of the preceding claims, **characterized in that** the hose end guiding line (35) attached to the receiving assembly (90) is kept in a tensioned manner by paying out and retrieving the hose end guiding line (35) in accordance with the movement of the receiving assembly (90) relative to the support structure (200).
7. Arrangement for connection of at least one hose in accordance with claim 6, **characterized in that** it is adapted for the paying out and retrieving the hose end guiding line (35) used for establishing a reference for accommodation of the guide means (102) into the receiving means (71) in accordance with the movement of the first structure (80).
8. Arrangement for connection of at least one hose in accordance with one of the preceding claims, **characterized in that** the weight of the hose end connector (91) is adapted to cause the lowering of the hose end connector (91) along the hose end guiding line (35).
9. Arrangement for connection of at least one hose in accordance in accordance with one of the preceding claims, **characterized in that** landing and dampening means is provided for controlling the pivoting movement of the hose end connector (91) into the connecting position with the receiving pipe coupling.

10. Arrangement for connection of at least one hose in accordance with one of the preceding claims, **characterized**
in that the hose end connector (91) and receiving pipe coupling is provided with adjustment means (160) to position the hose end connector (91) to fit with the corresponding receiving pipe coupling (15). 5
11. Arrangement for connection of at least one hose in accordance with claim 10, **characterized**
in that the adjustment means (160) comprise one or more flexible joints allowing for the controlled displacement of the hose end connector (91) relative to the guide means (102). 10
12. Arrangement for connection of at least one hose in accordance with one of the preceding claims, **characterized**
in that locking means (157) such as hydraulic activated claws is provided for locking the hose end connector (91) to the receiving pipe coupling (15) in the connecting position. 15
13. Arrangement for connection of at least one hose in accordance with one of the preceding claims, **characterized**
in that alignment means is provided to position the hose end connector to fit further with the corresponding receiving pipe coupling. 20
14. Arrangement for connection of at least one hose in accordance with claim 13, **characterized**
in that the alignment means include a dampening unit (152). 25
15. Arrangement for connection of at least one hose in accordance with one of the preceding claims, **characterized**
in that the receiving assembly (90) is arranged with at least one receiving pipe coupling (15) provided with adaptation means for fitting the at least one receiving pipe coupling with a specific hose end connector (91) and the receiving means (71) is located above the receiving pipe coupling (15). 30
16. Arrangement for connection of at least one hose, in accordance with claim 15, **characterized**
in that the adaptation means comprise an interface element with a configuration adaptable to preset the interface element to fit with the specific dimension/outlay of each hose end connector (91). 35
17. Arrangement for connection of at least one hose end connector, in accordance with one of the preceding claims 15-16, **characterized**
in that the receiving pipe coupling (15) is provided with adjustment means (160) to position the hose end connector (91) to fit with the corresponding receiving pipe coupling (15). 40
18. Method for connection of at least one hose carrying fluid especially LNG and/or vaporized LNG, wherein a hose end of the at least one hose has a hose end connector (91) to be connected to a receiving assembly (90) on a first structure (80) located in water, wherein the hose end connector (91) is provided with guide means (102) and the receiving assembly (90) is provided with receiving means (71), wherein the receiving means is located above the receiving pipe coupling of the receiving assembly (90), wherein handling means is provided for controlling the hose end connector (91) and positioning the guide means relative to the receiving assembly (90), wherein the handling means comprises a hose end suspension line (27) arranged with lifting and lowering devices, said hose end suspension line (27) being suspended from a support structure and connected to the hose end connector, the handling means comprises further a hose end guiding line (35) arranged with lifting and lowering devices being supported by the support structure (200) and connected to the hose end, wherein the method includes the following steps:
- attaching the hose end guiding line (35) to the receiving assembly (90),
- lowering the hose end suspension line (27) and
- guiding the hose end connector (91) along the hose end guiding line (35).
- positioning the guide means (102) to be accommodated in the receiving means (71),
- accommodating the guide means (102) in the receiving means (71),
- transferring the weight of the hose end connector (91) to the receiving means (71),
- moving the hose end connector (91) by a pivoting movement, into a connecting position with a receiving pipe coupling (15). 45
19. Method for disconnection of at least one hose carrying fluid especially LNG and/or vaporized LNG, wherein a hose end of the at least one hose has a hose end connector (91) which is in a connecting position with a receiving pipe coupling of a receiving assembly (90) on a first structure (80) located in water, wherein the hose end connector (91) belongs to a hose carrying fluid especially LNG and/or vaporized LNG, and the hose end connector (91) is provided with guide means (102) accommodated in receiving means (71) included in the receiving assembly (90), where the receiving means is located above the receiving pipe coupling of the receiving assembly (90), wherein the handling means is provided for controlling the hose end connector (91) and positioning the guide means (102) relative to the receiving assembly, wherein the handling means is provided with 50

a hose end suspension line (27) and a hose end guiding line (35, whereby said hose end suspension line (27) is suspended from a support structure (200) and connected to the hose end connector (91), and said hose end guiding line (35) arranged with lifting and lowering devices is supported by the support structure and connected to the hose end connector (91), wherein the method includes the following disconnecting steps:

- lifting the hose end suspension line (27) and
- guiding the hose end connector (91) along the hose end guiding line (35),
- moving the hose end connector (91) from a connected position with a receiving pipe coupling (15) in the receiving assembly (90) into a disconnecting position away from the receiving pipe coupling (15) by a pivoting movement,
- relieving the guide means (102) from an accommodated position in the receiving means (71), and transferring the weight of the hose end connector (91) from the receiving means (71) to the handling means and
- moving the hose end connector (91) away from the receiving assembly (90).

Patentansprüche

1. Anordnung zum Anschluss mindestens eines Fluid, insbesondere LNG und/oder verdampftes LNG, transportierenden Schlauchs, wobei die Anordnung den Schlauch, einen Schlauchende-Anschluss (91), eine Aufnahmeeinheit (90) und eine in Wasser befindliche erste Struktur (80) aufweist, wobei ein Schlauchende (63) des mindestens einen Schlauchs einen Schlauchende-Anschluss (91) hat, der an die Aufnahmeeinheit (90) der im Wasser befindlichen ersten Struktur (80) anzuschließen ist, wobei der Schlauchende-Anschluss (91) mit einer Führungseinrichtung (102) versehen ist, und die Aufnahmeeinheit (90) mit einer Aufnahmeeinrichtung (71) versehen ist, wobei die Anordnung eine Handhabeinrichtung zum Steuern des Schlauchende-Anschlusses (91) hat, um die Führungseinrichtung (102) in der Aufnahmeeinrichtung (71) zu positionieren und die Führungseinrichtung (102) so in die Aufnahmeeinrichtung (71) einzubringen, dass die Führungseinrichtung in der Aufnahmeeinrichtung (71) gehalten ist, **dadurch gekennzeichnet, dass** das Gewicht des Schlauchende-Anschlusses (91) dazu angepasst ist, auf die Aufnahmeeinrichtung (71) übertragen zu werden, dass der Schlauchende-Anschluss (91) dazu ausgelegt ist, eine Anschlussposition mit einer Aufnahmerohrkupplung (15) in der Aufnahmeeinheit (90) einzunehmen, wobei eine Aufnahmerohrkupplung

lung (15) für jeden Schlauchende-Anschluss (91) vorgesehen ist, dass sich die Aufnahmeeinrichtung (71) über der Aufnahmerohrkupplung (15) der Aufnahmeeinheit (90) befindet, wobei für die Führungseinrichtung (102) vorgesehen ist, sich in der Aufnahmeeinrichtung (71) mit dem Schlauchende-Anschluss (91) zu verschwenken, wodurch der Schlauchende-Anschluss (91) eine Schwenkbewegung macht, wenn der Schlauchende-Anschluss (91) in die Anschlussposition mit der Aufnahmerohrkupplung (15) gebracht wird, dass die Handhabeinrichtung eine Anhebe- und Absenkeinrichtung aufweist, die eine Schlauchende-Führungsleitung (35) und eine Schlauchende-Aufhängungsleitung (27) aufweist, die beide mit dem Schlauchende-Anschluss (91) verbunden sind, welche Schlauchende-Führungsleitung (35) und Schlauchende-Aufhängungsleitung (27) von einer Stützstruktur (200) abgehängt sind und durch Anhebe- und Absenkvorrichtungen gesteuert werden, dass die Schlauchende-Führungsleitung (35) dazu ausgelegt ist, an der Aufnahmeeinheit (90) angebracht zu werden, dass die Positionierung des Schlauchende-Anschlusses (91) durch Absenken der Schlauchende-Aufhängungsleitung (27) gesteuert wird, wodurch der Schlauchende-Anschluss (91) entlang der Schlauchende-Führungsleitung (35) bewegt wird.

2. Anordnung zum Anschluss mindestens eines Schlauchs, nach Anspruch 1, **dadurch gekennzeichnet, dass** das Gewicht des Schlauchende-Anschlusses (91) von der Handhabeinrichtung aus auf die Aufnahmeeinrichtung (71) übertragen wird.
3. Anordnung zum Anschluss mindestens eines Schlauchs, nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** sie zum Steuern des Schlauchende-Anschlusses (91) angepasst ist, um die Führungseinrichtung (102) in Übereinstimmung mit der Bewegung der ersten Struktur (80) in die Aufnahmeeinrichtung (71) einzubringen.
4. Anordnung zum Anschluss mindestens eines Schlauchs, nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Aufnahmeeinrichtung (71) als eine zur Aufnahme der Führungseinrichtung (102) zugeschnittene Mulde geformt ist.
5. Anordnung zum Anschluss mindestens eines Schlauchs, nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** eine Schlauchführungs- und Schlauchhalterungsstruktur (300) an der ersten Struktur (80) vorgesehen ist, um das Schlauchende (63) zu halten und einen Teil des Gewichts des Schlauchendes (63) und des Schlauchende-Anschlusses (91) zu tragen, wenn der Schlauchende-Anschluss (91) an die Aufnahmeein-

heit (90) angeschlossen ist.

6. Anordnung zum Anschluss mindestens eines Schlauchs, nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die an der Aufnahmeeinheit (90) angebrachte Schlauchende-Führungsleitung (35) gespannt gehalten wird, indem die Schlauchende-Führungsleitung (35) in Übereinstimmung mit der Bewegung der Aufnahmeeinheit (90) in Bezug auf die Stützstruktur (200) ausgegeben und eingeholt wird. 5
7. Anordnung zum Anschluss mindestens eines Schlauchs, nach Anspruch 6, **dadurch gekennzeichnet, dass** sie dazu angepasst ist, die Schlauchende-Führungsleitung (35) auszugeben und einzuholen, die dazu verwendet wird, einen Bezug zur Aufnahme der Führungseinrichtung (102) in der Aufnahmeeinrichtung (71) in Übereinstimmung mit der Bewegung der ersten Struktur (80) herzustellen. 10
8. Anordnung zum Anschluss mindestens eines Schlauchs, nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Gewicht des Schlauchende-Anschlusses (91) dazu angepasst ist, das Absenken des Schlauchende-Anschlusses (91) entlang der Schlauchende-Führungsleitung (35) zu bewirken. 15
9. Anordnung zum Anschluss mindestens eines Schlauchs, nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** eine Anlege- und Dämpfungseinrichtung vorgesehen ist, um die Schwenkbewegung des Schlauchende-Anschlusses (91) in die Anschlussposition mit der Aufnahmerohrkupplung zu steuern. 20
10. Anordnung zum Anschluss mindestens eines Schlauchs, nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Schlauchende-Anschluss (91) und die Aufnahmerohrkupplung mit Einstelleinrichtungen (160) zum Positionieren des Schlauchende-Anschlusses (91) versehen ist, damit er sich mit der entsprechenden Aufnahmerohrkupplung (15) zusammenfügt. 25
11. Anordnung zum Anschluss mindestens eines Schlauchs, nach Anspruch 10, **dadurch gekennzeichnet, dass** die Einstelleinrichtungen (160) ein flexibles oder mehrere flexible Gelenk/e aufweisen, das bzw. die die gesteuerte Verlagerung des Schlauchende-Anschlusses (91) in Bezug auf die Führungseinrichtung (102) ermöglichen. 30
12. Anordnung zum Anschluss mindestens eines Schlauchs, nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** eine Festsetzungseinrichtung (157), wie etwa hydraulisch betätigte Krallen, zum Festsetzen des Schlauchende-Anschlusses (91) an der Aufnahmerohrkupplung (15) in der Anschlussposition vorgesehen ist. 35
13. Anordnung zum Anschluss mindestens eines Schlauchs, nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** eine Ausrichtungseinrichtung zum Positionieren des Schlauchende-Anschlusses vorgesehen ist, damit er sich weiter mit der entsprechenden Aufnahmerohrkupplung zusammenfügt. 40
14. Anordnung zum Anschluss mindestens eines Schlauchs, nach Anspruch 13, **dadurch gekennzeichnet, dass** die Ausrichtungseinrichtung eine Dämpfungseinheit (152) hat. 45
15. Anordnung zum Anschluss mindestens eines Schlauchs, nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Aufnahmeeinheit (90) mit mindestens einer Aufnahmerohrkupplung (15) eingerichtet ist, die mit Anpassungsmitteln versehen ist, um die mindestens eine Aufnahmerohrkupplung mit einem speziellen Schlauchende-Anschluss (91) zusammenzufügen, und sich die Aufnahmeeinrichtung (71) über der Aufnahmerohrkupplung (15) befindet. 50
16. Anordnung zum Anschluss mindestens eines Schlauchs, nach Anspruch 15, **dadurch gekennzeichnet, dass** die Anpassungseinrichtungen ein Verbindungselement mit einer anpassbaren Auslegung aufweisen, um das Verbindungselement vor einzustellen, damit es zur speziellen Abmessung/Auslegung jedes Schlauchende-Anschlusses (91) passt. 55
17. Anordnung zum Anschluss mindestens eines Schlauchs, nach einem der vorhergehenden Ansprüche 15 - 16, **dadurch gekennzeichnet, dass** die Aufnahmerohrkupplung (15) mit einer Einstelleinrichtung (160) zum Positionieren des Schlauchende-Anschlusses (91) versehen ist, damit er zur entsprechenden Aufnahmerohrkupplung passt.
18. Verfahren zum Anschließen eines Fluid, insbesondere LNG und/oder verdampftes LNG, transportierenden Schlauchs, wobei ein Schlauchende des mindestens einen Schlauchs einen Schlauchende-Anschluss (91) hat, der an eine Aufnahmeeinheit (90) an einer in Wasser befindlichen ersten Struktur (80) anzuschließen ist, wobei der Schlauchende-Anschluss (91) mit einer Führungseinrichtung (102) versehen ist, und die Aufnahmeeinheit (90) mit einer Aufnahmeeinrichtung (71) versehen ist, wobei sich die Aufnahmeeinrichtung über der Aufnahmerohrkupplung der Aufnahmeeinheit (90) befindet, wobei

eine Handabeeinrichtung zum Steuern des Schlauchende-Anschlusses (91) und zum Positionieren der Führungseinrichtung in Bezug auf die Aufnahmeeinheit (90) vorgesehen ist, wobei die Handabeeinrichtung eine Schlauchende-Aufhängungsleitung (27) aufweist, die mit Anhebe- und Absenkvorrichtungen eingerichtet ist, wobei die Schlauchende-Aufhängungsleitung (27) von einer Stützstruktur abgehängt und mit dem Schlauchende-Anschluss (91) verbunden ist, die Handabeeinrichtung darüber hinaus eine mit Anhebe- und Absenkvorrichtungen eingerichtete Schlauchende-Führungsleitung (35) aufweist, die von der Stützstruktur (200) gehalten und mit dem Schlauchende verbunden ist, wobei das Verfahren die folgenden Schritte umfasst:

- Anbringen der Schlauchende-Führungsleitung (35) an der Aufnahmeeinheit (90),
- Absenken der Schlauchende-Aufhängungsleitung (27), und
- Führen des Schlauchende-Anschlusses (91) entlang der Schlauchende-Führungsleitung (35),
- Positionieren der Führungseinrichtung (102), und zwar so, dass sie in die Aufnahmeeinrichtung (71) aufgenommen ist,
- Aufnehmen der Führungseinrichtung (102) in die Aufnahmeeinrichtung (71),
- Übertragen des Gewichts des Schlauchende-Anschlusses (91) auf die Aufnahmeeinrichtung (71),
- Bewegen des Schlauchende-Anschlusses (91) durch eine Schwenkbewegung in eine Anschlussposition mit einer Aufnahmerohrkupplung (15).

19. Verfahren zum Lösen mindestens eines Fluid, insbesondere LNG und/oder verdampftes LNG, transportierenden Schlauchs, wobei ein Schlauchende des mindestens einen Schlauchs einen Schlauchende-Anschluss (91) hat, der in einer Anschlussposition mit einer Aufnahmerohrkupplung einer Aufnahmeeinheit (90) an einer in Wasser befindlichen ersten Struktur (80) ist, wobei der Schlauchende-Anschluss (91) zu einem Schlauch gehört, der ein Fluid, speziell LNG und/oder verdampftes LNG transportiert, und der Schlauchende-Anschluss (91) mit einer Führungseinrichtung (102) versehen ist, die in einer in der Aufnahmeeinheit (90) enthaltene Führungseinrichtung (71) aufgenommen ist, wobei sich die Aufnahmeeinrichtung über der Aufnahmerohrkupplung der Aufnahmeeinheit (90) befindet, wobei die Handabeeinrichtung zum Steuern des Schlauchende-Anschlusses (91) und Positionieren der Führungseinrichtung (102) in Bezug auf die Aufnahmeeinheit vorgesehen ist, wobei die Handabeeinrichtung mit einer Schlauchende-Aufhängungsleitung (27) und einer Schlauchende-Führungsleitung

(35) versehen ist, wobei die Schlauchende-Aufhängungsleitung (27) von einer Stützstruktur (200) abgehängt und mit dem Schlauchende-Anschluss (91) verbunden ist, und die mit Anhebe- und Absenkvorrichtungen eingerichtete Schlauchende-Führungsleitung (35) durch die Stützstruktur gehalten und mit dem Schlauchende-Anschluss (91) verbunden ist, wobei das Verfahren die folgenden Löseschritte umfasst:

- Anheben der Schlauchende-Aufhängungsleitung (27), und
- Führen des Schlauchende-Anschlusses (91) entlang der Schlauchende-Führungsleitung (35),
- Bewegen des Schlauchende-Anschlusses (91) durch eine Schwenkbewegung von einer angeschlossenen Position mit einer Aufnahmerohrkupplung (15) in der Aufnahmeeinheit (90) in eine von der Aufnahmerohrkupplung (15) entfernte Löseposition,
- Befreien der Führungseinrichtung (102) aus einer in der Aufnahmeeinrichtung (71) aufgenommenen Position, und Übertragen des Gewichts des Schlauchende-Anschlusses (91) von der Aufnahmeeinrichtung (71) auf die Handabeeinrichtung, und
- Wegbewegen des Schlauchende-Anschlusses (91) von der Aufnahmeeinheit (90).

Revendications

1. Agencement pour le raccordement d'au moins un tuyau transportant un fluide notamment du GNL et/ou du GNL vaporisé, ledit agencement comprend ledit tuyau, un raccord d'extrémité de tuyau (91), un ensemble de réception (90) et une première structure (80) située dans l'eau dans lequel une extrémité de tuyau (63) de l'au moins un tuyau a un raccord d'extrémité de tuyau (91) qui doit être raccordé audit ensemble de réception (90) sur ladite première structure (80) située dans l'eau, dans lequel le raccord d'extrémité de tuyau (91) est pourvu d'un moyen de guidage (102) et l'ensemble de réception (90) est pourvu d'un moyen de réception (71), dans lequel l'agencement comporte un moyen de manipulation pour commander au raccord d'extrémité de tuyau (91) de positionner le moyen de guidage (102) dans le moyen de réception (71) et de loger le moyen de guidage (102) dans le moyen de réception (71) de sorte que le moyen de guidage (102) soit supporté dans le moyen de réception (71),
caractérisé en ce que le poids du raccord d'extrémité de tuyau (91) est adapté pour être transféré au moyen de réception (71), **en ce que** le raccord d'extrémité de tuyau (91) est configuré pour adopter une position de raccordement avec un accouplement de

- tuyau de réception (15) dans l'ensemble de réception (90), avec un accouplement de tuyau de réception (15) prévu pour chaque raccord d'extrémité de tuyau (91), **en ce que** le moyen de réception (71) est situé au-dessus de l'accouplement de tuyau de réception (15) de l'ensemble de réception (90), permettant au moyen de guidage (102) de pivoter dans le moyen de réception (71) avec le raccord d'extrémité de tuyau (91) réalisant un mouvement de pivotement, lorsque le raccord d'extrémité de tuyau (91) est amené dans la position de raccordement avec l'accouplement de tuyau de réception (15), **en ce que** le moyen de manipulation comprend un moyen de montée et de descente qui comprend un câble de guidage d'extrémité de tuyau (35) et un câble de suspension d'extrémité de tuyau (27) tous deux raccordés au raccord d'extrémité de tuyau (91), dont le câble de guidage d'extrémité de tuyau (35) et le câble de suspension d'extrémité de tuyau (27) sont suspendus depuis une structure de support (200) et commandés par des dispositifs de montée et de descente, **en ce que** le câble de guidage d'extrémité de tuyau (35) est configuré pour être fixé à l'ensemble de réception (90), **en ce que** le positionnement du raccord d'extrémité de tuyau (91) est commandé en descendant le câble de suspension d'extrémité de tuyau (27) déplaçant ainsi le raccord d'extrémité de tuyau (91) le long du câble de guidage d'extrémité de tuyau (35).
2. Agencement pour le raccordement d'au moins un tuyau selon la revendication 1, **caractérisé en ce que** le poids du raccord d'extrémité de tuyau (91) est transféré au moyen de réception (71) à partir du moyen de manipulation.
 3. Agencement pour le raccordement d'au moins un tuyau selon la revendication 1 ou 2, **caractérisé en ce qu'il** est adapté pour commander le raccord d'extrémité de tuyau (91) afin de loger le moyen de guidage (102) dans le moyen de réception (71) conformément au déplacement de la première structure (80).
 4. Agencement pour le raccordement d'au moins un tuyau selon l'une des revendications précédentes, **caractérisé en ce que** le moyen de réception (71) est en forme de berceau équipé pour recevoir le moyen de guidage (102).
 5. Agencement pour le raccordement d'au moins un tuyau selon l'une des revendications précédentes, **caractérisé en ce qu'une** structure de guidage et de support de tuyau (300) est prévue sur la première structure (80) pour supporter l'extrémité de tuyau (63) et supporter une portion du poids de l'extrémité de tuyau (63) et du raccord d'extrémité de tuyau (91), lorsque le raccord d'extrémité de tuyau (91) est raccordé à l'ensemble de réception (90).
 6. Agencement pour le raccordement d'au moins un tuyau selon l'une des revendications précédentes, **caractérisé en ce que** le câble de guidage d'extrémité de tuyau (35) fixé à l'ensemble de réception (90) est maintenu tendu en déroulant et en récupérant le câble de guidage d'extrémité de tuyau (35) suivant le déplacement de l'ensemble de réception (90) par rapport à la structure de support (200).
 7. Agencement pour le raccordement d'au moins un tuyau selon la revendication 6, **caractérisé en ce qu'il** est adapté pour le déroulement et la récupération du câble de guidage d'extrémité de tuyau (35) utilisé pour établir une référence pour le logement du moyen de guidage (102) dans le moyen de réception (71) selon le déplacement de la première structure (80).
 8. Agencement pour le raccordement d'au moins un tuyau selon l'une des revendications précédentes, **caractérisé en ce que** le poids du raccord d'extrémité de tuyau (91) est adapté pour provoquer la descente du raccord d'extrémité de tuyau (91) le long du câble de guidage d'extrémité de tuyau (35).
 9. Agencement pour le raccordement d'au moins un tuyau flexible selon l'une des revendications précédentes, **caractérisé en ce qu'un** moyen d'atterrissage et d'amortissement est prévu pour commander le mouvement pivotant du raccord d'extrémité de tuyau (91) dans la position de raccordement avec l'accouplement de tuyau de réception.
 10. Agencement pour le raccordement d'au moins un tuyau selon l'une des revendications précédentes, **caractérisé en ce que** le raccord d'extrémité de tuyau (91) et l'accouplement de tuyau de réception sont pourvus de moyens de réglage (160) pour positionner le raccord d'extrémité de tuyau (91) afin qu'il s'ajuste à l'accouplement de tuyau de réception (15) correspondant.
 11. Agencement pour le raccordement d'au moins un tuyau selon la revendication 10, **caractérisé en ce que** les moyens de réglage (160) comprennent un ou plusieurs joints flexibles permettant le déplacement commandé du raccord d'extrémité de tuyau (91) par rapport au moyen de guidage (102).
 12. Agencement pour le raccordement d'au moins un tuyau selon l'une des revendications précédentes, **caractérisé en ce qu'un** moyen de verrouillage (157) tel que des

mâchoires activées hydrauliquement est prévu pour verrouiller le raccord d'extrémité de tuyau (91) à l'accouplement de tuyau de réception (15) dans la position de raccordement.

13. Agencement pour le raccordement d'au moins un tuyau l'une des revendications précédentes, **caractérisé**

en ce qu'un moyen d'alignement est prévu pour positionner le raccord d'extrémité de tuyau afin qu'il s'ajuste davantage à l'accouplement de tuyau de réception correspondant.

14. Agencement pour le raccordement d'au moins un tuyau selon la revendication 13, **caractérisé**
en ce que le moyen d'alignement comporte une unité d'amortissement (152).

15. Agencement pour le raccordement d'au moins un tuyau selon l'une des revendications précédentes, **caractérisé**

en ce que l'ensemble de réception (90) est agencé avec au moins un accouplement de tuyau de réception (15) pourvu d'un moyen d'adaptation pour équiper l'au moins un accouplement de tuyau de réception avec un raccord d'extrémité de tuyau (91) spécifique et le moyen de réception (71) est situé au-dessus de l'accouplement de tuyau de réception (15).

16. Agencement pour le raccordement d'au moins un tuyau selon la revendication 15, **caractérisé**
en ce que le moyen d'adaptation comprend un élément d'interface avec une configuration adaptable pour prérégler l'élément d'interface pour qu'il s'ajuste à la dimension/au contour spécifique de chaque raccord d'extrémité de tuyau (91).

17. Agencement pour le raccordement d'au moins un raccord d'extrémité de tuyau selon l'une des revendications 15 et 16 précédentes, **caractérisé**

en ce que l'accouplement de tuyau de réception (15) est pourvu d'un moyen de réglage (160) pour positionner le raccord d'extrémité de tuyau (91) pour qu'il s'ajuste à l'accouplement de tuyau de réception (15) correspondant.

18. Procédé de raccordement d'au moins un tuyau transportant un fluide notamment du GNL et/ou du GNL vaporisé, dans lequel une extrémité de tuyau de l'au moins un tuyau a un raccord d'extrémité de tuyau flexible (91) à raccorder à un ensemble de réception (90) sur une première structure (80) située dans l'eau, dans lequel le raccord d'extrémité de tuyau (91) est pourvu d'un moyen de guidage (102) et l'ensemble de réception (90) est pourvu d'un moyen de réception (71), dans lequel le moyen de

réception est situé au-dessus de l'accouplement de tuyau de réception de l'ensemble de réception (90), dans lequel un moyen de manipulation est prévu pour commander le raccord d'extrémité de tuyau (91) et positionner le moyen de guidage par rapport à l'ensemble de réception (90), dans lequel le moyen de manipulation comprend un câble de suspension d'extrémité de tuyau (27) agencé avec des dispositifs de montée et de descente, ledit câble de suspension d'extrémité de tuyau (27) étant suspendu depuis une structure de support et raccordé au raccord d'extrémité de tuyau, le moyen de manipulation comprend en outre un câble de guidage d'extrémité de tuyau (35) agencé avec des dispositifs de montée et de descente supportés par la structure de support (200) et raccordés à l'extrémité de tuyau, dans lequel le procédé comporte les étapes suivantes :

- la fixation du câble de guidage d'extrémité de tuyau (35) à l'ensemble de réception (90),
- la descente du câble de suspension d'extrémité de tuyau (27) et
- le guidage du raccord d'extrémité de tuyau (91) le long du câble de guidage d'extrémité de tuyau (35),
- le positionnement du moyen de guidage (102) pour qu'il soit logé dans le moyen de réception (71),
- le logement du moyen de guidage (102) dans le moyen de réception (71),
- le transfert du poids du raccord d'extrémité de tuyau (91) au moyen de réception (71),
- le déplacement du raccord d'extrémité de tuyau (91) par un mouvement pivotant, dans une position de raccordement avec un accouplement de tuyau de réception (15).

19. Procédé de débranchement d'au moins un tuyau transportant un fluide notamment du GNL et/ou du GNL vaporisé, dans lequel une extrémité de tuyau de l'au moins un tuyau a un raccord d'extrémité de tuyau (91) qui est dans une position de raccordement avec un accouplement de tuyau de réception d'un ensemble de réception (90) sur une première structure (80) située dans l'eau, dans lequel le raccord d'extrémité de tuyau (91) appartient à un tuyau transportant un fluide notamment du GNL et/ou du GNL vaporisé, et le raccord d'extrémité de tuyau (91) est pourvu d'un moyen de guidage (102) logé dans un moyen de réception (71) inclus dans l'ensemble de réception (90), où le moyen de réception est situé au-dessus de l'accouplement de tuyau de réception de l'ensemble de réception (90), dans lequel le moyen de manipulation est prévu pour commander le raccord d'extrémité de tuyau flexible (91) et positionner le moyen de guidage (102) par rapport à l'ensemble de réception, dans lequel le moyen de ma-

nipulation est pourvu d'un câble de suspension d'extrémité de tuyau (27) et d'un câble de guidage d'extrémité de tuyau (35), moyennant quoi ledit câble de suspension d'extrémité de tuyau (27) est suspendu depuis une structure de support (200) et raccordé au raccord d'extrémité de tuyau (91), et ledit câble de guidage d'extrémité de tuyau flexible (35) agencé avec des dispositifs de montée et de descente est supporté par la structure de support et raccordée au raccord d'extrémité de tuyau (91), dans lequel le procédé comporte les étapes de débranchement suivantes :

- la montée du câble de suspension d'extrémité de tuyau (27) et
- le guidage du raccord d'extrémité de tuyau (91) le long du câble de guidage d'extrémité de tuyau (35),
- le déplacement du raccord d'extrémité de tuyau (91) d'une position raccordée avec un accouplement de tuyau de réception (15) dans l'ensemble de réception (90) à une position de débranchement en éloignement de l'accouplement de tuyau de réception (15) par un mouvement pivotant,
- le relâchement du moyen de guidage (102) d'une position logée dans le moyen de réception (71), et le transfert du poids du raccord d'extrémité de tuyau (91) depuis le moyen de réception (71) au moyen de manipulation et
- le déplacement du raccord d'extrémité de tuyau flexible (91) en éloignement de l'ensemble de réception (90).

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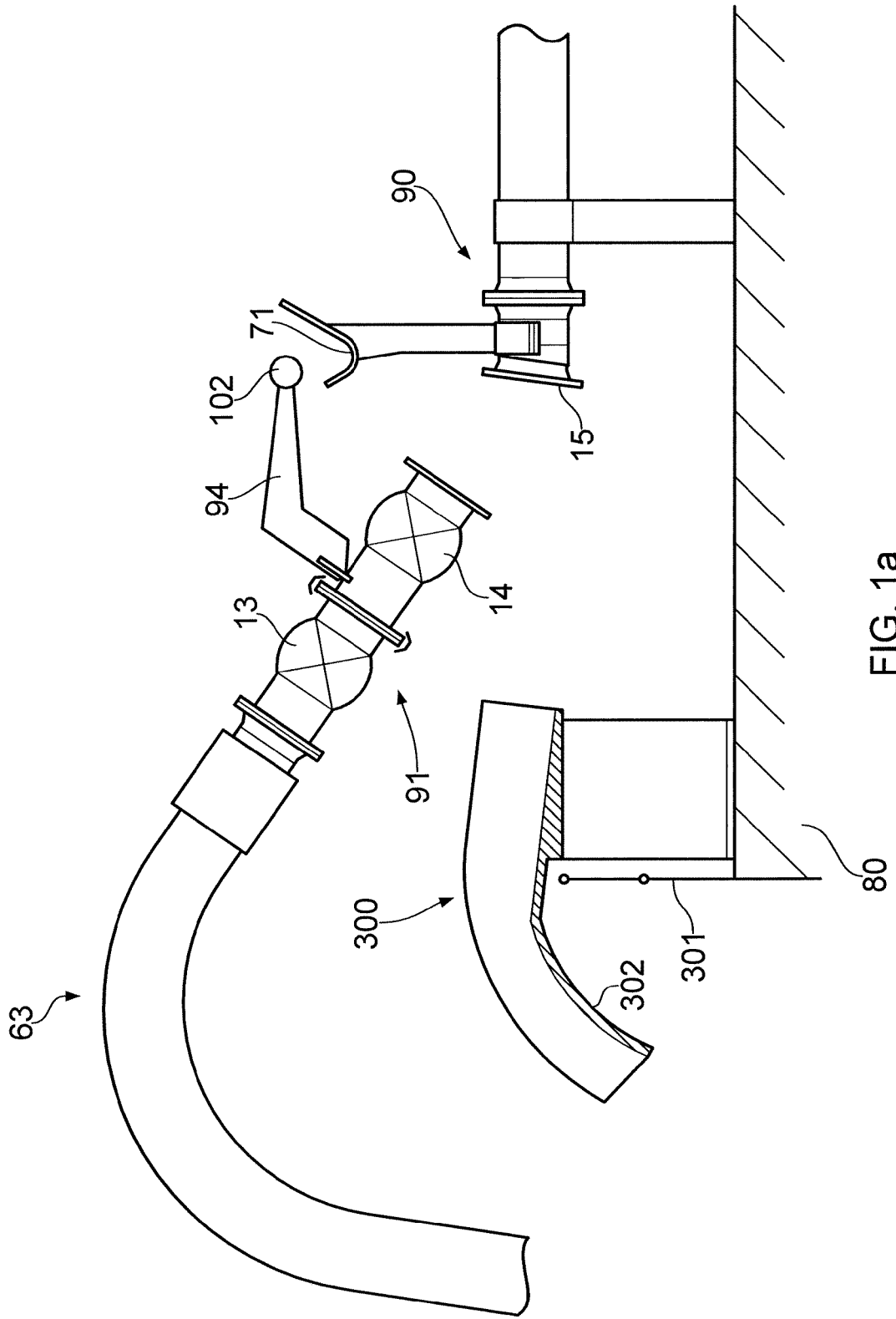
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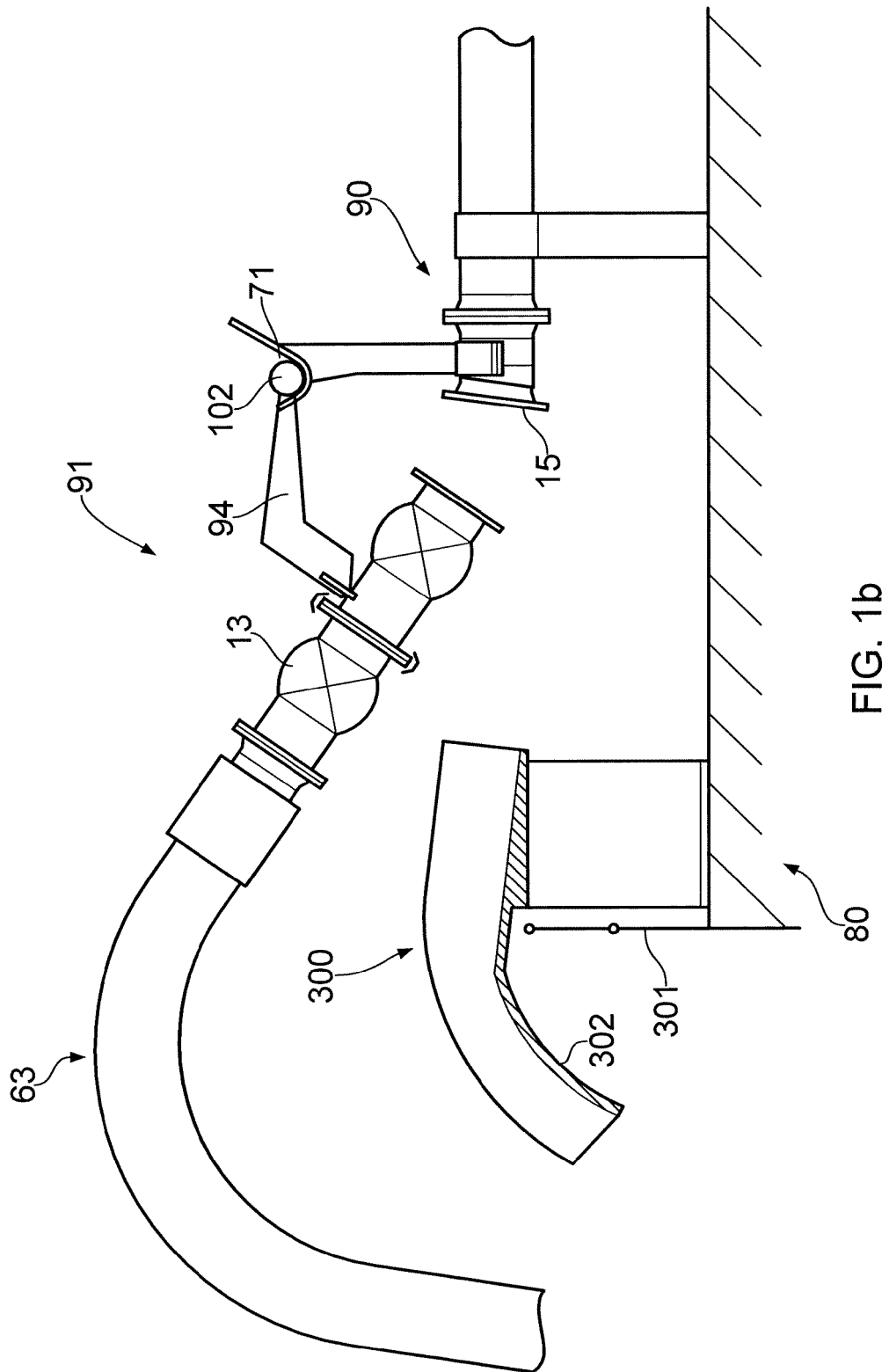
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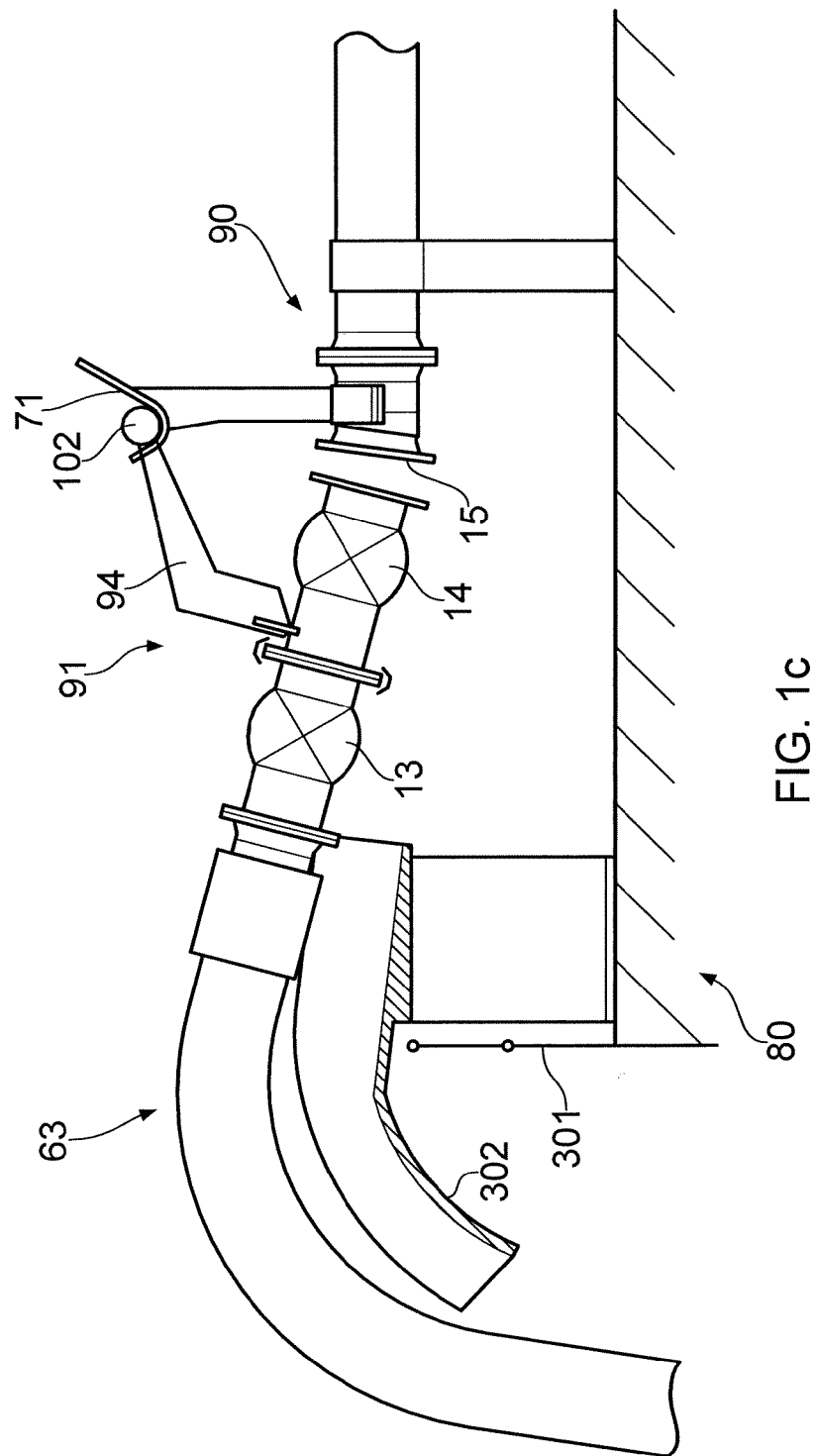
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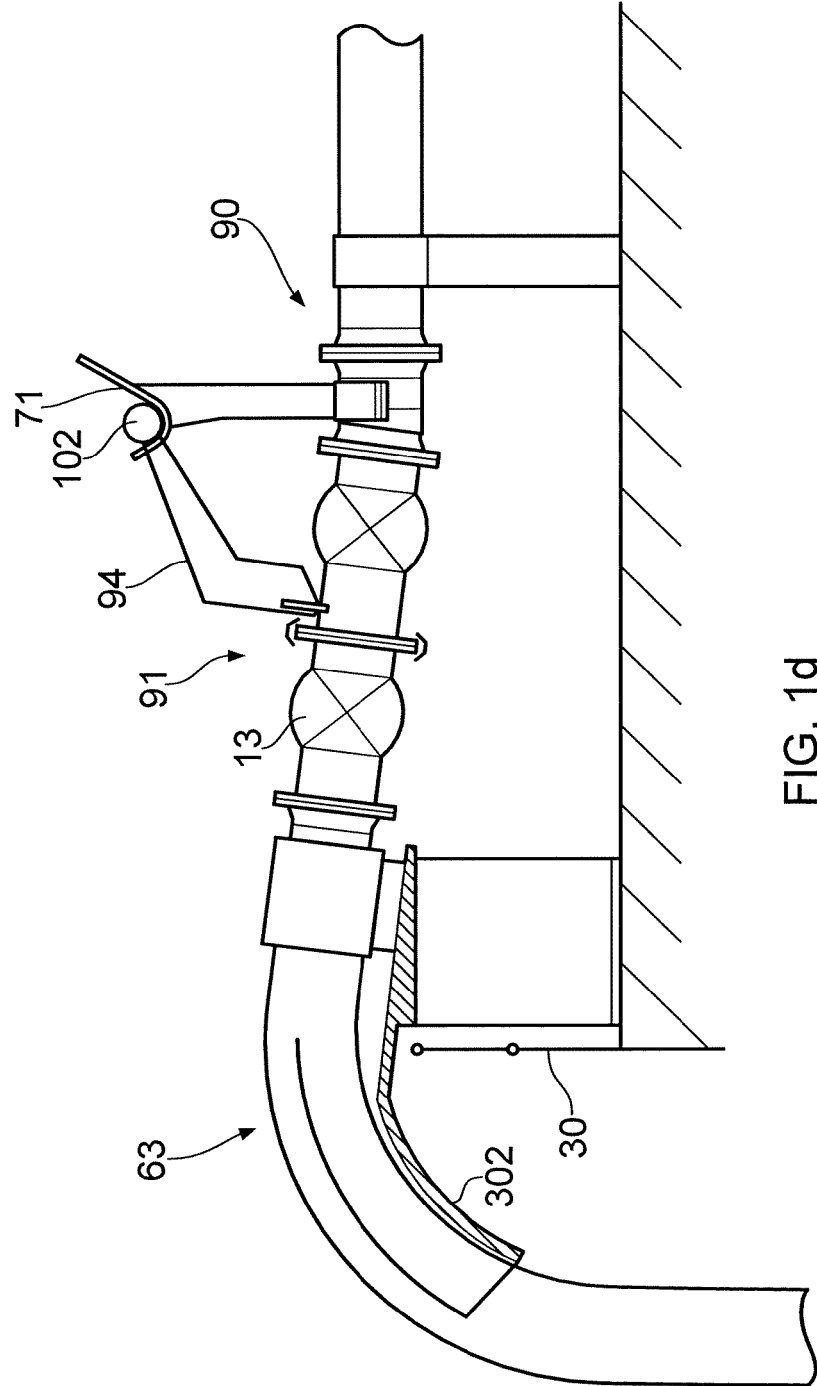
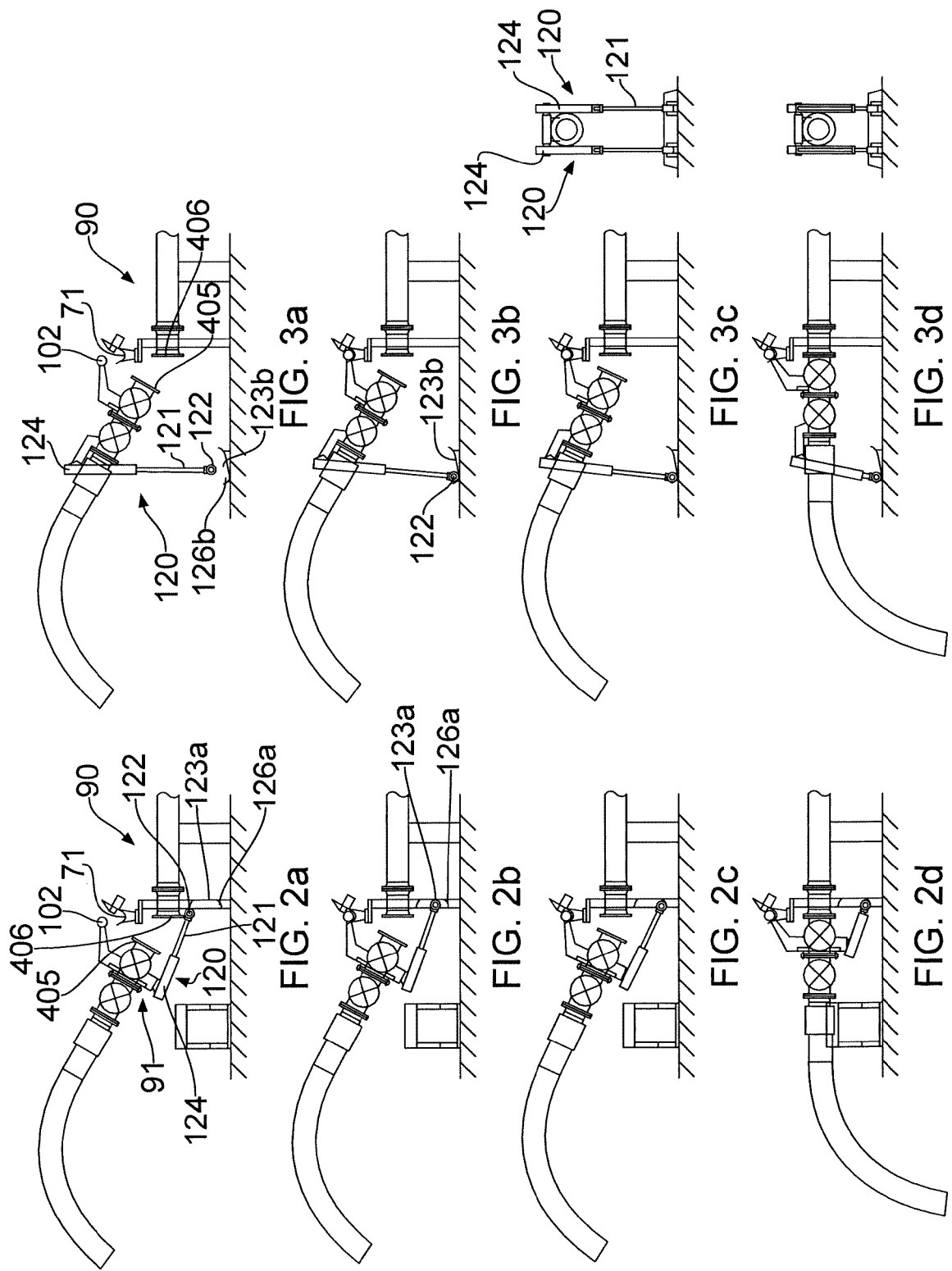


FIG. 1d



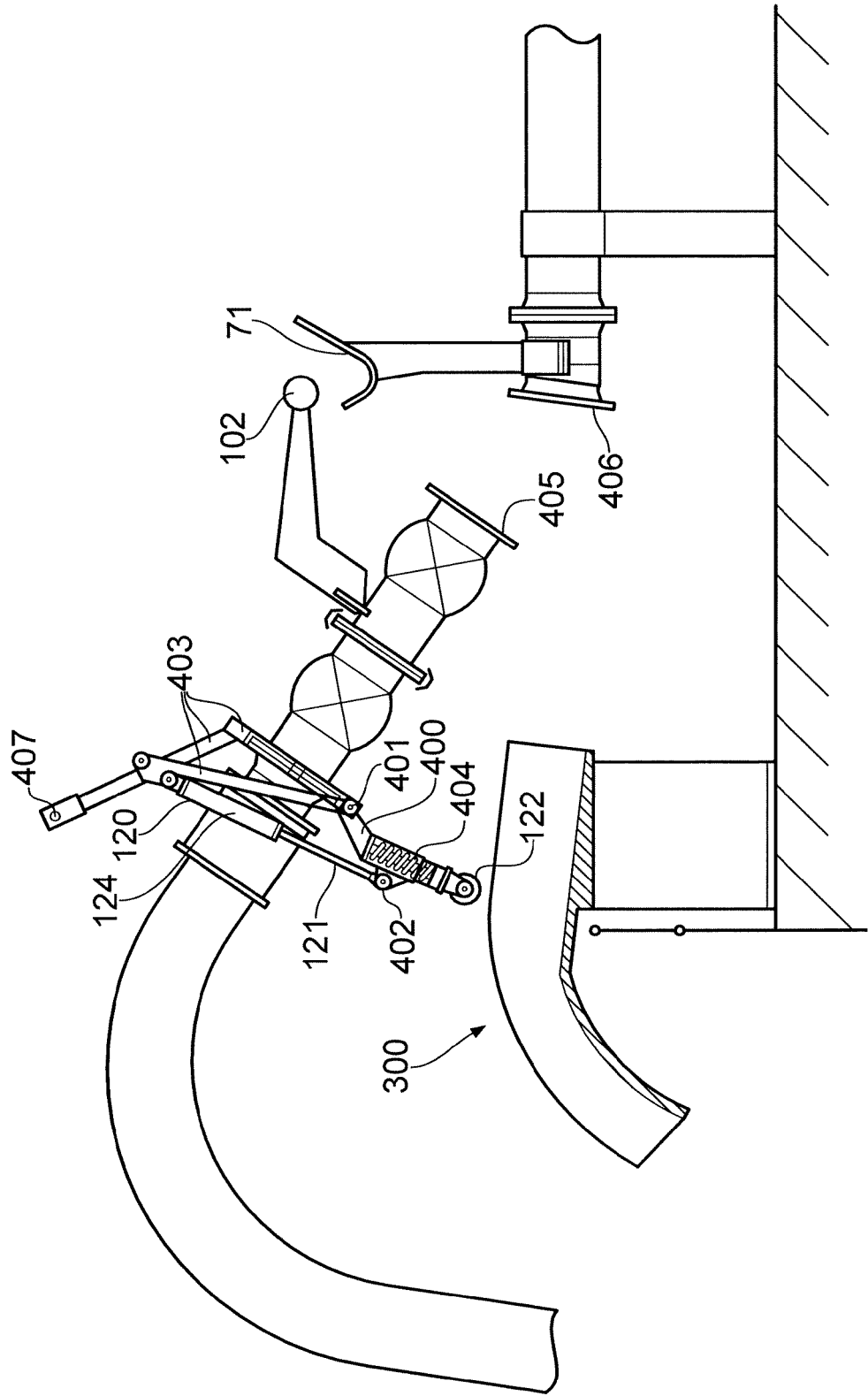


FIG. 3e

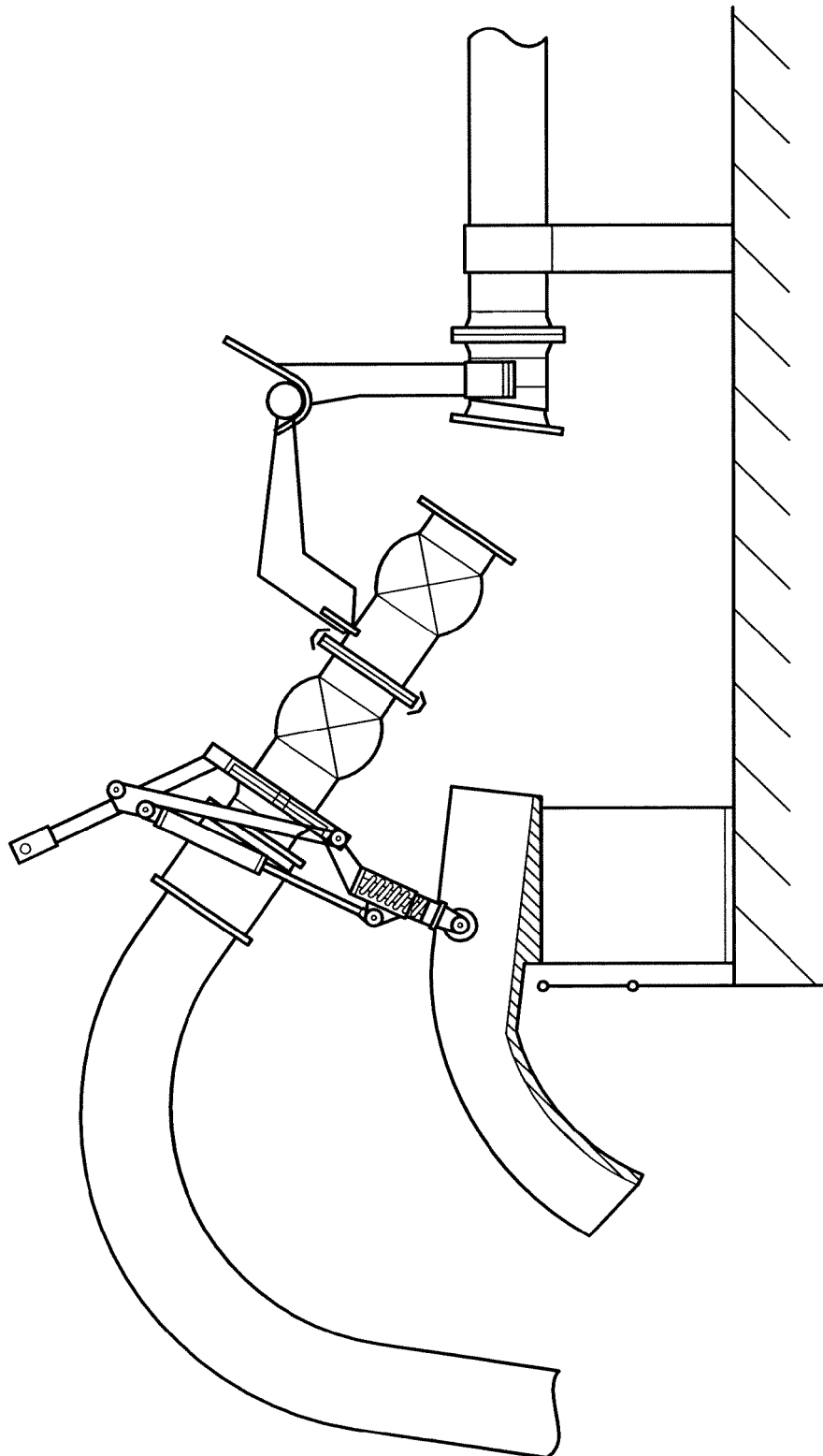


FIG. 3f

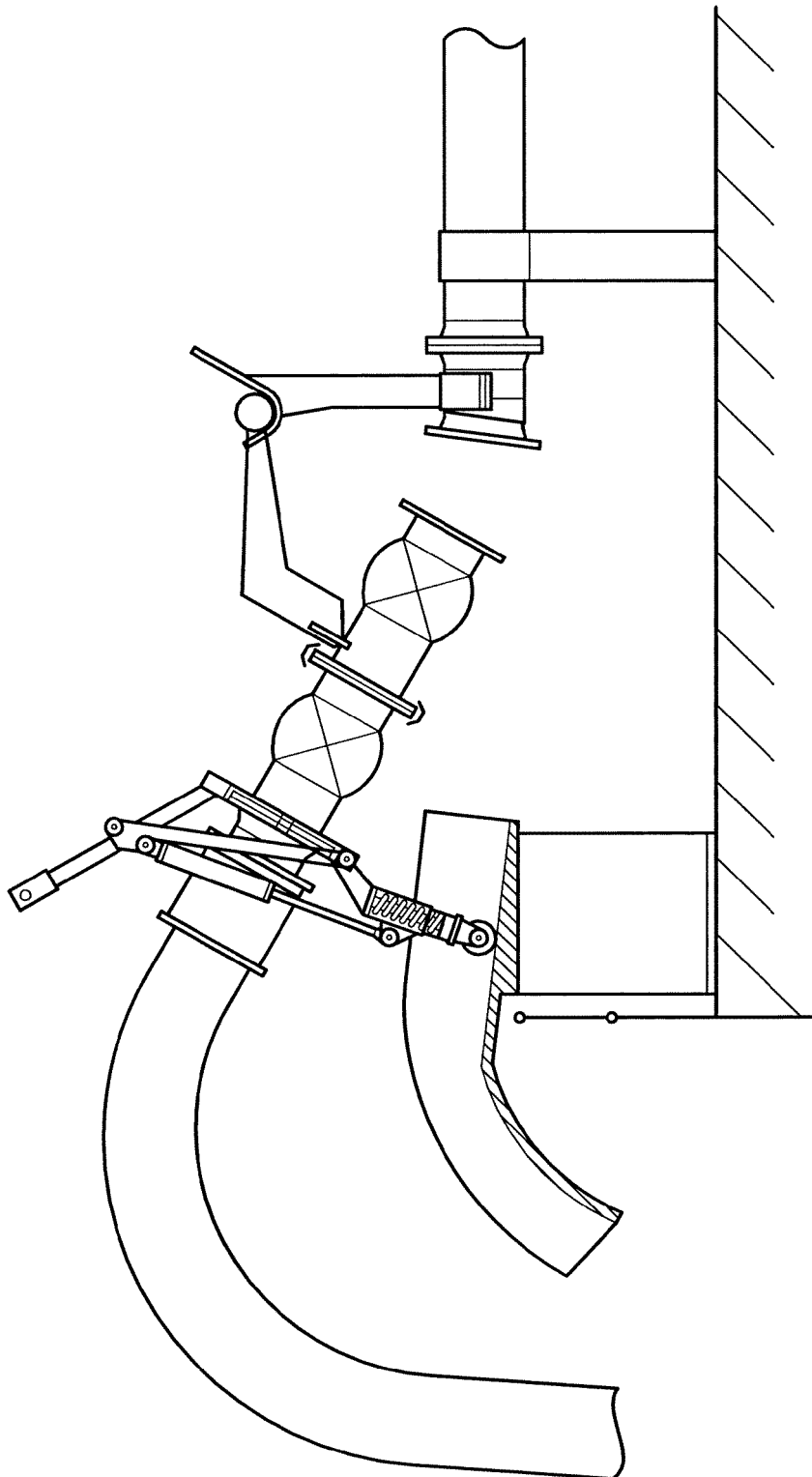


FIG. 3g

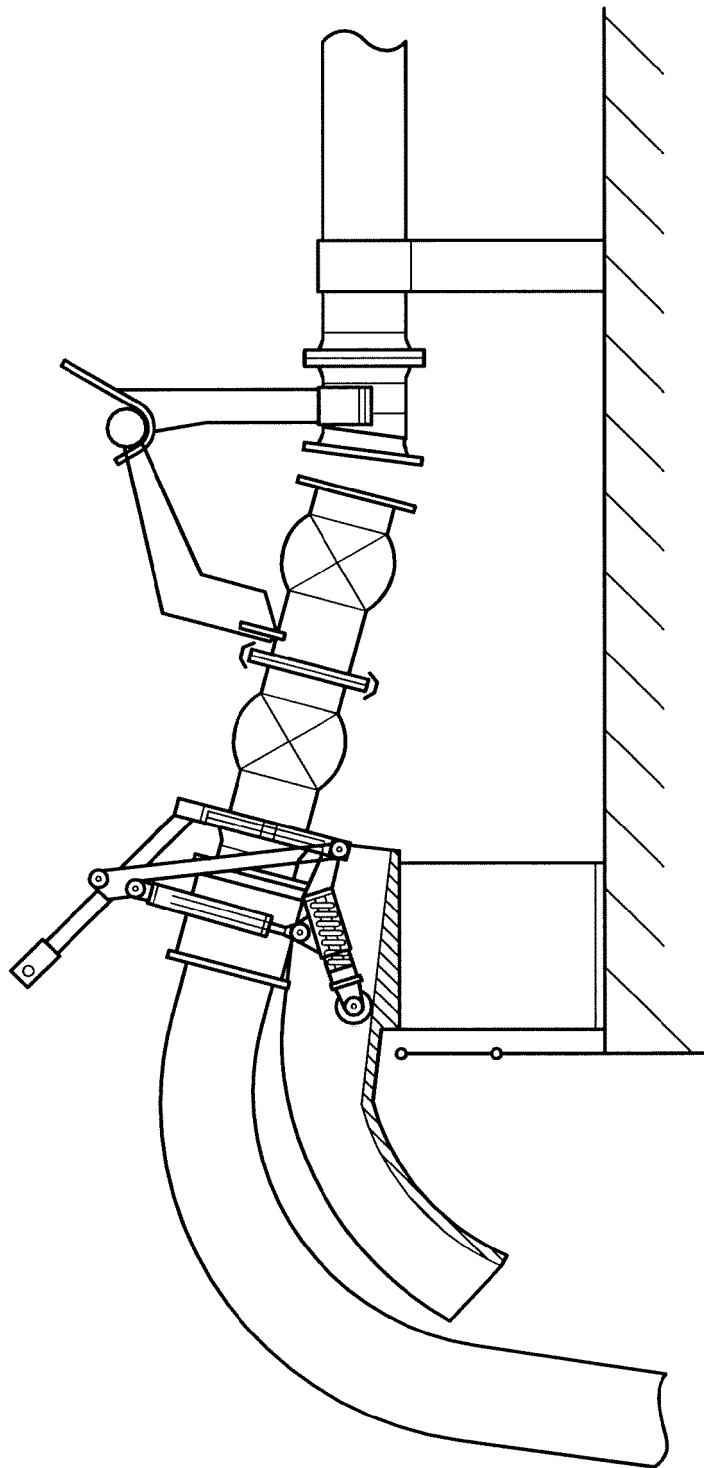


FIG. 3h

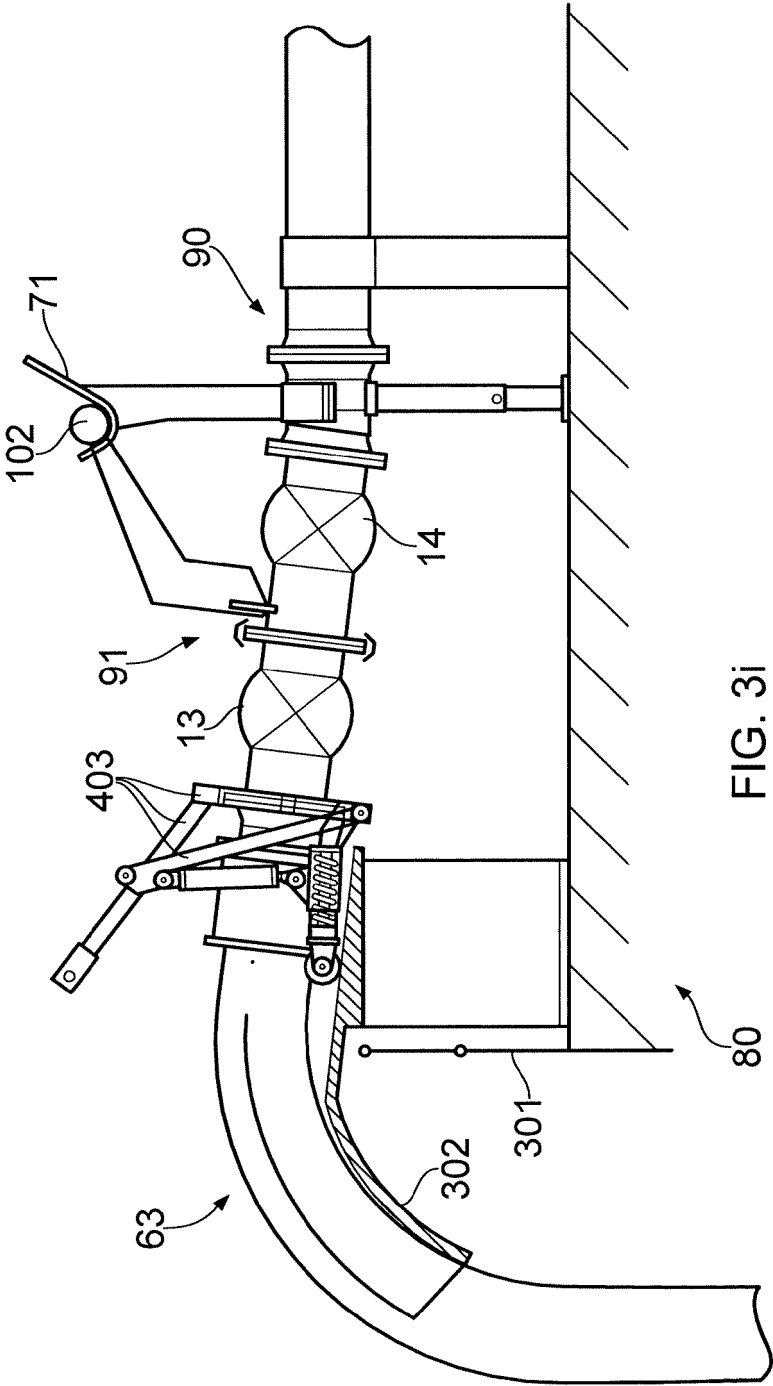


FIG. 3i

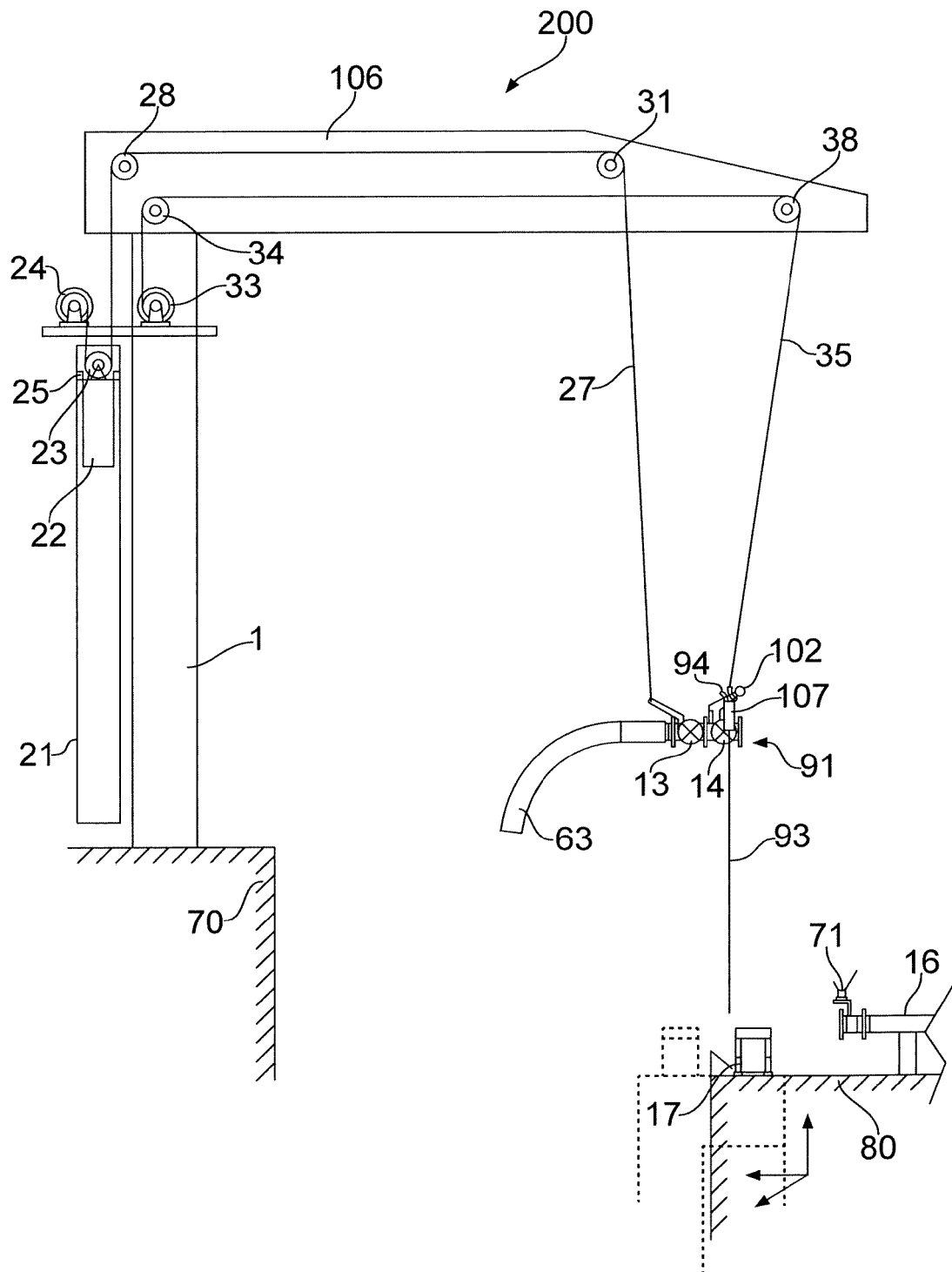


FIG. 4a

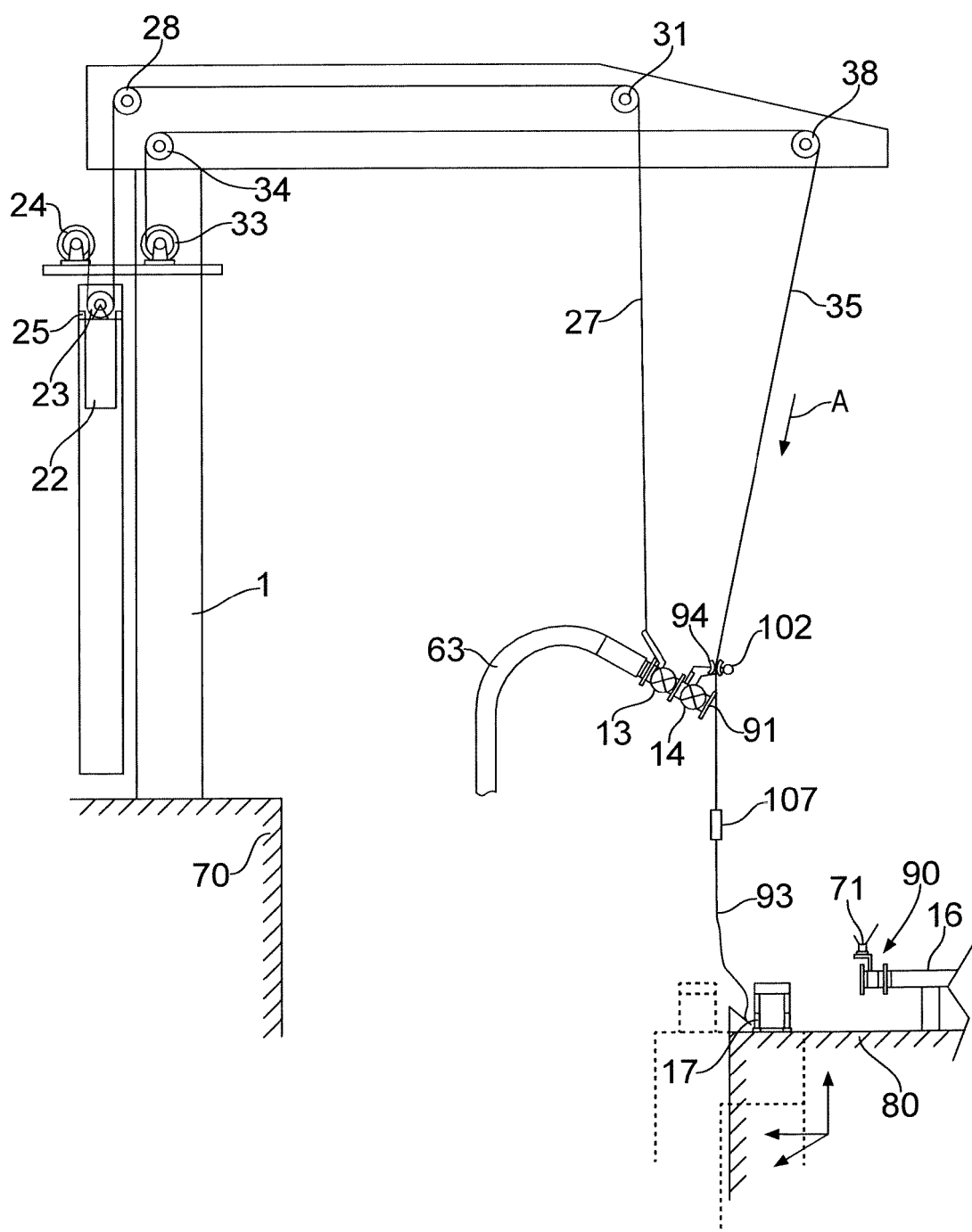


FIG. 4b

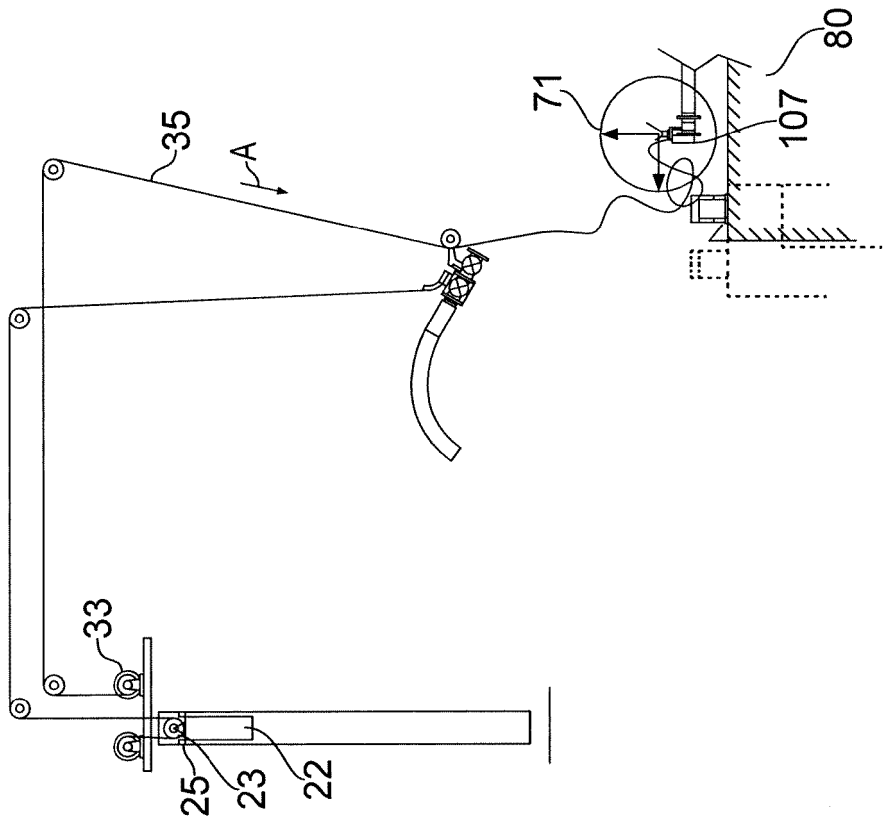


FIG. 4c

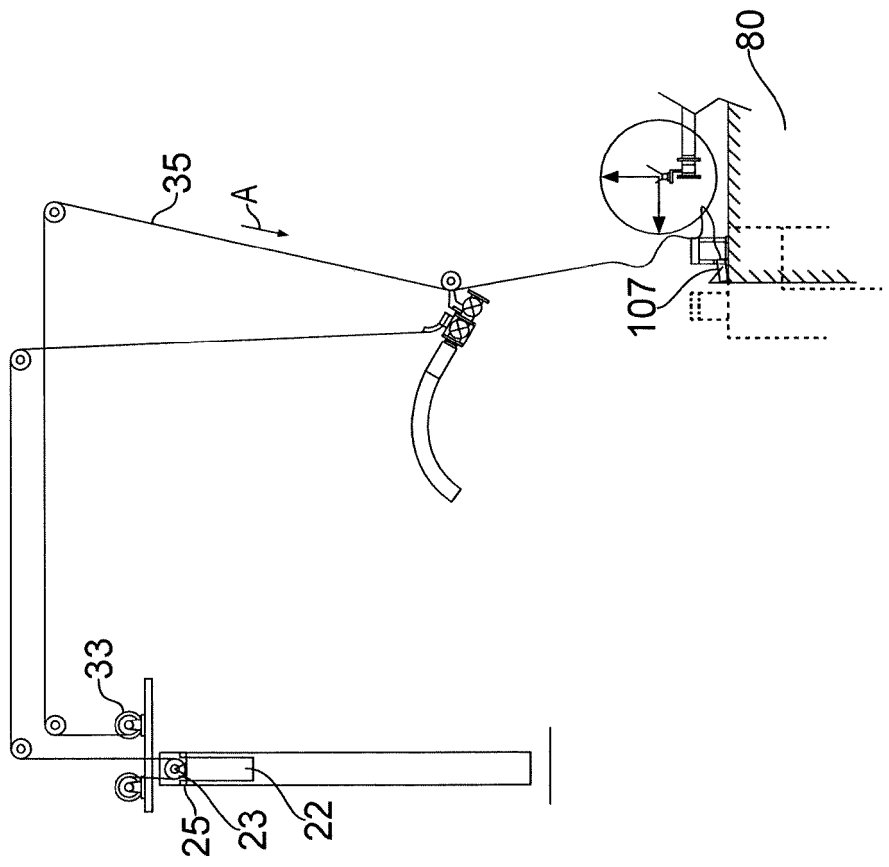
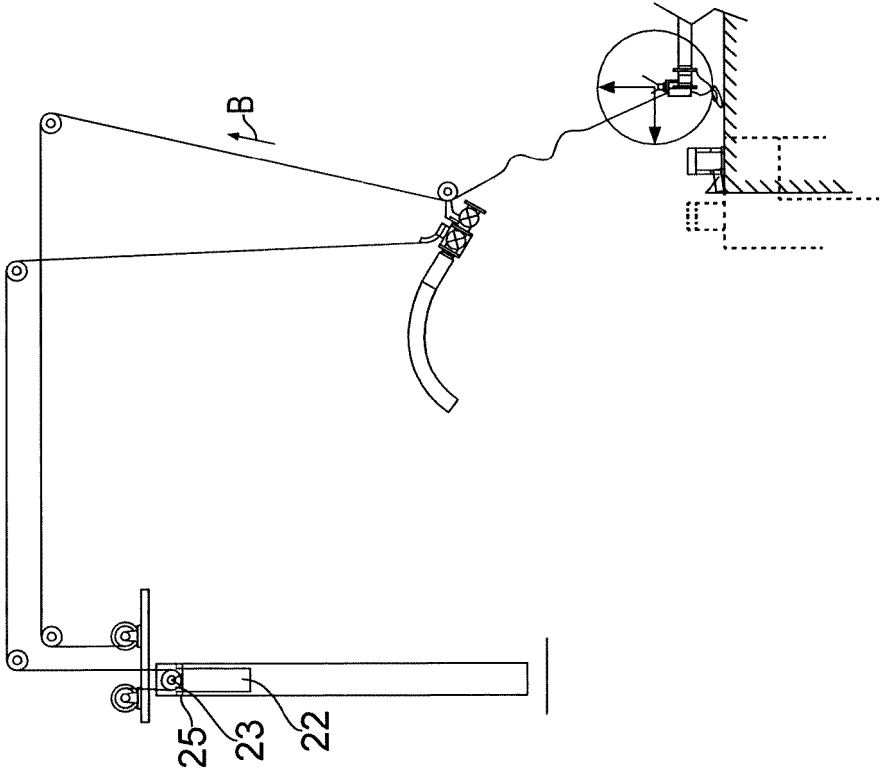
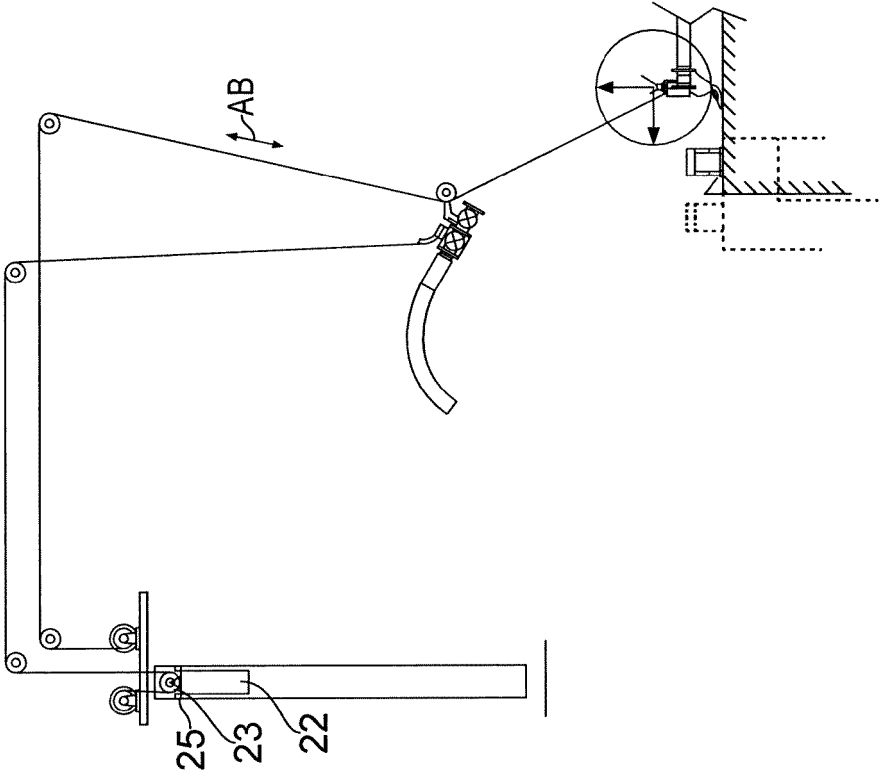


FIG. 4d



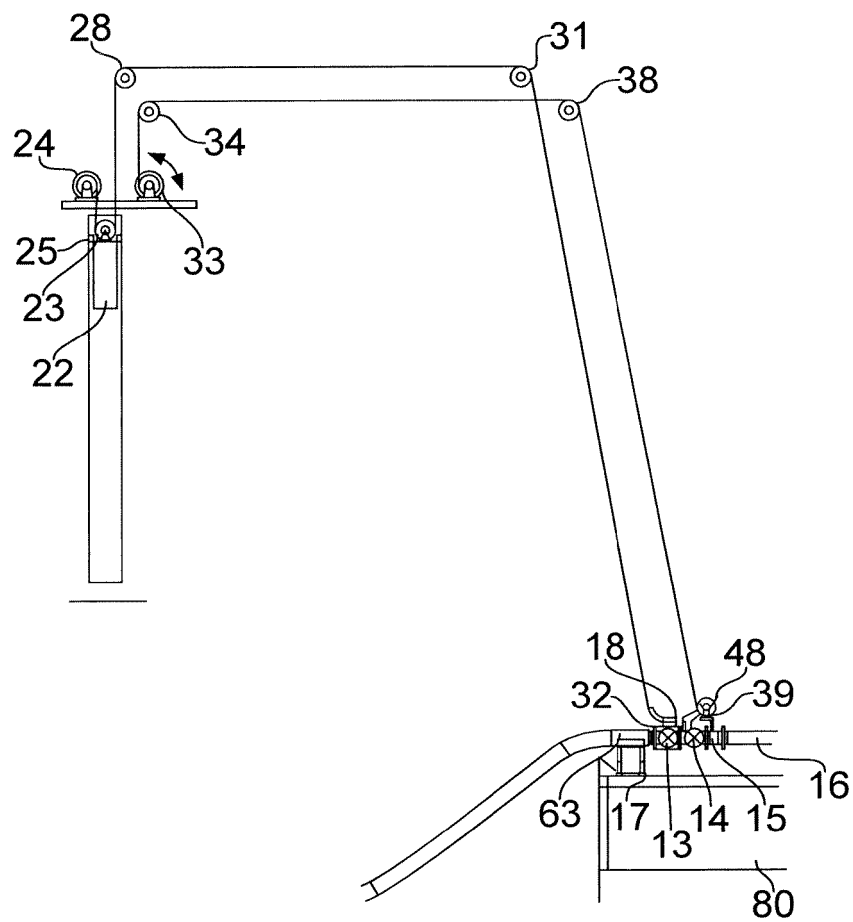


FIG. 4g

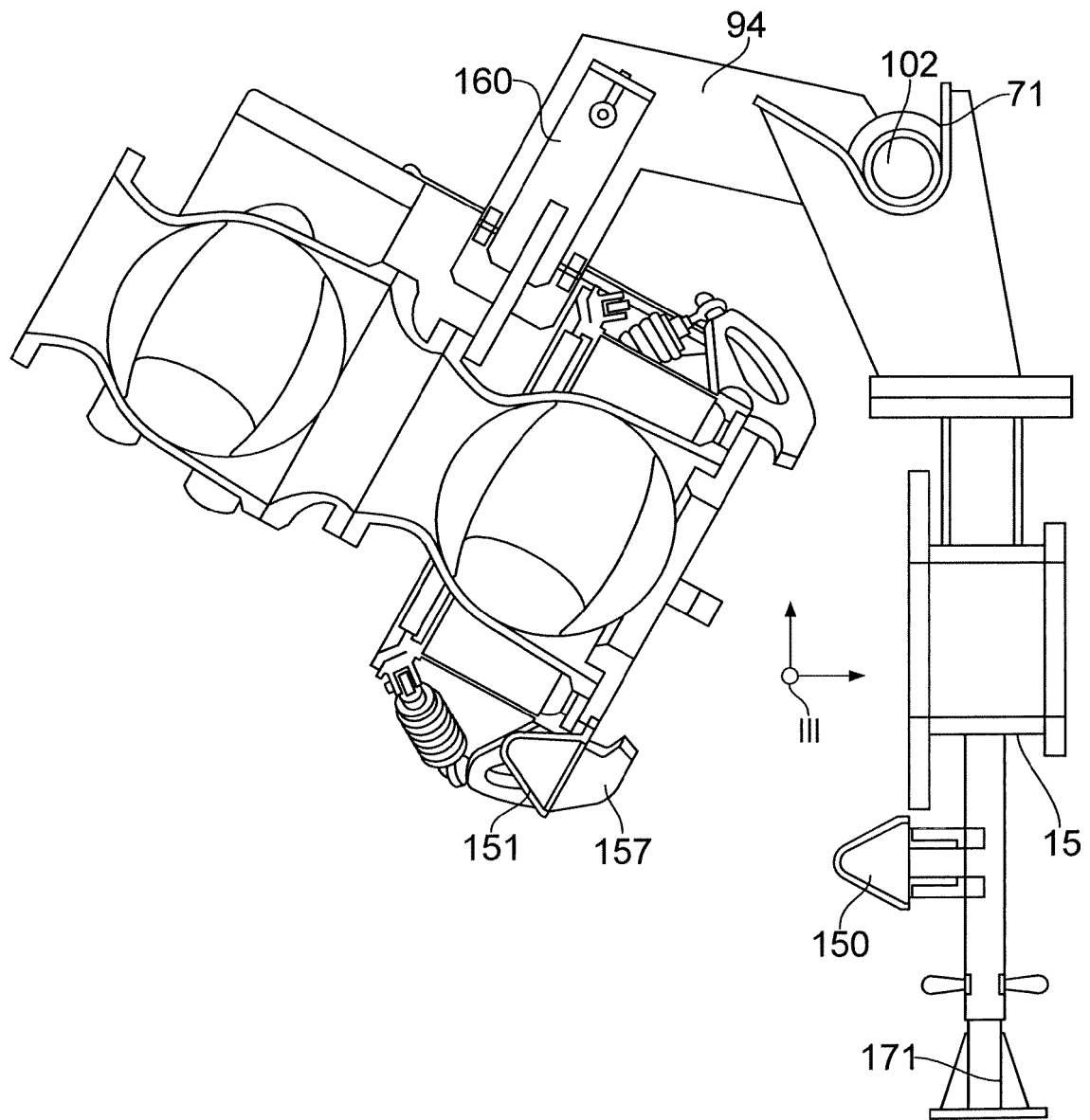


FIG. 5a

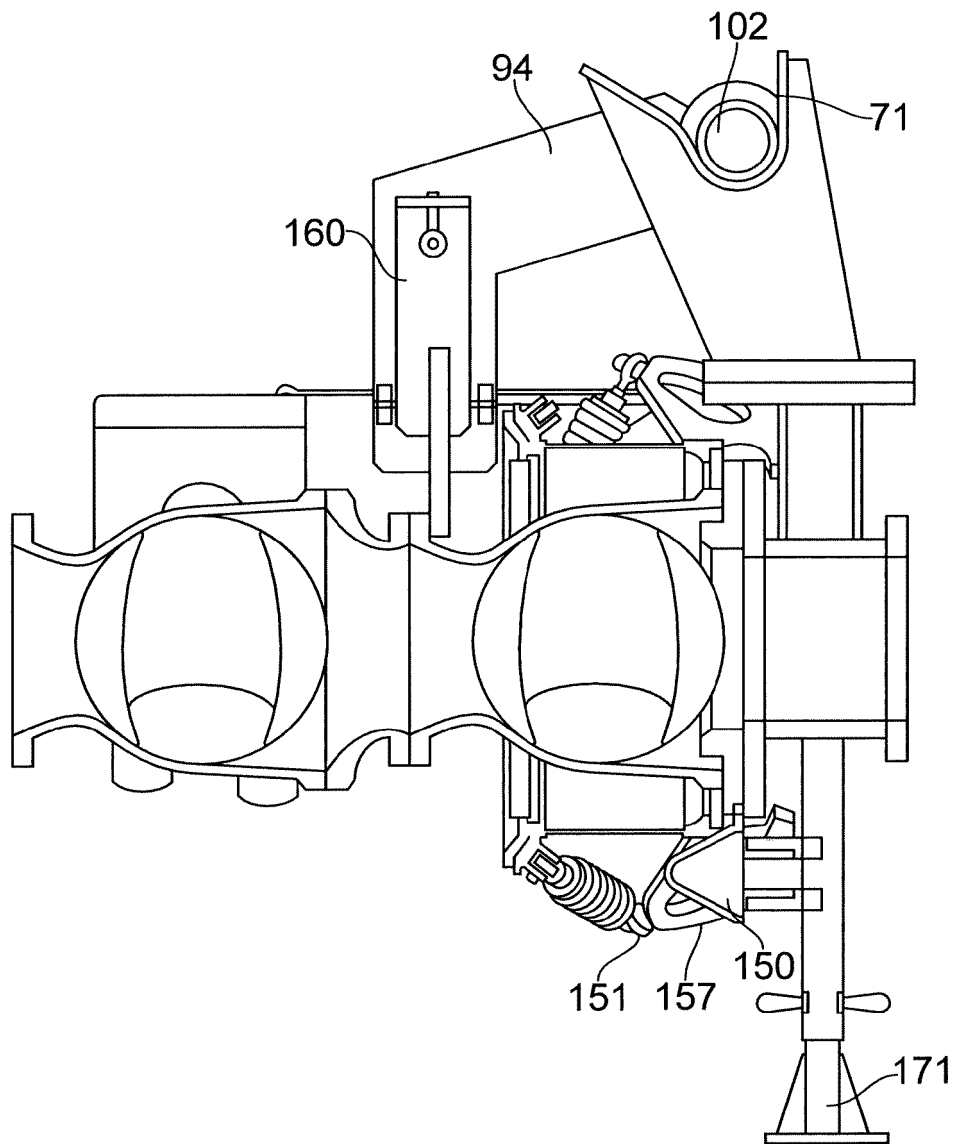


FIG. 5b

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2010137990 A [0006]
- US 2914080 A [0006]
- WO 2007113203 A [0006]
- GB 900877 A [0006]
- US 2818891 A [0006]
- US 2922446 A [0006]
- US 3228421 A [0006]

Non-patent literature cited in the description

- **CHARLES HUGHES ; RENAUD LE DEVEHAT.** The All Metal LNG Offloading System for the Adriatic LNG Terminal. *Gastech conference*, 2006 [0006]