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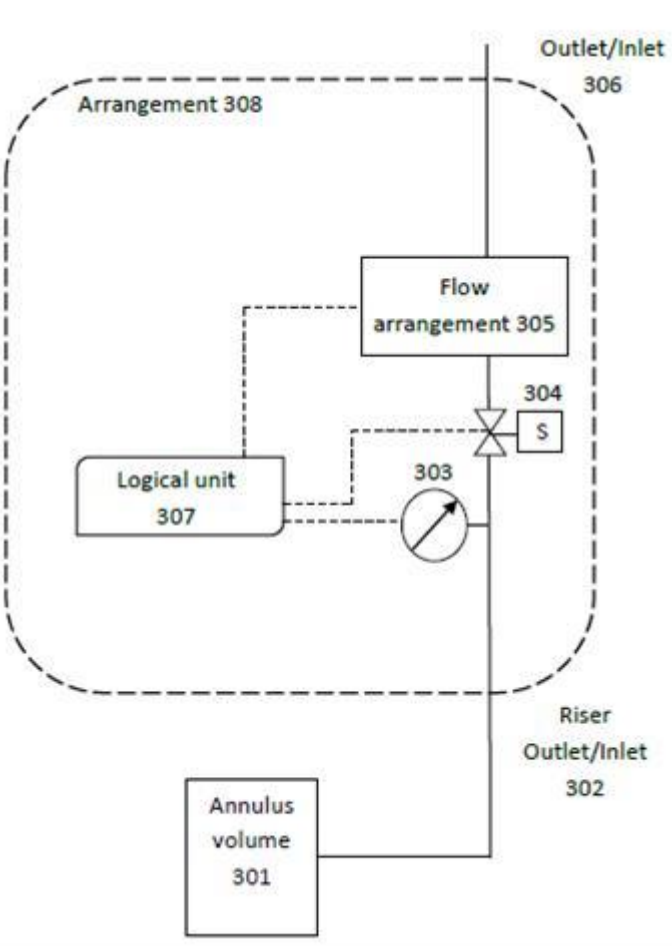
(54) Title **Portable arrangement for automatical annulus testing**

(57) Abstract

The present invention is related to integrity monitoring of an annulus free volume in a flexible pipe. More specifically, the invention is related to a portable arrangement for automatic determination of the annulus free volume of a flexible pipe.



PORTABLE ARRANGEMENT FOR AUTOMATICAL ANNULUS TESTING

TECHNICAL AREA

The present invention is a portable arrangement for automatical annulus free volume testing. More specifically the invention is a portable arrangement for determination of annulus free volume of a flexible pipe using an automated sequence.

INVENTION BACKGROUND

Monitoring and integrity evaluation are performed to control and map the condition and quality of the annulus volume, typically in a flexible riser or flowline. As shown in figure 1, the annulus volume 102 in a flexible pipe is defined as the volume between the outer sheath 101 and the pressure barrier 103. Annulus testing for determining the annulus free volume is a significant part of evaluating the pipe integrity.

Based on such an annulus test, the pipe integrity can be evaluated by comparing the measured annulus free volume and knowledge of the total annulus volume. The annulus volume in a flexible pipe is expected to be dry or experience a slow filling with time due to for instance diffusion through the pipe pressure barrier. Annulus free volume testing, hereafter referred to as annulus testing, of flexible risers is today typically performed annually at offshore installations using specialist personnel. Figure 2 shows an example sketch of a typical offshore installation which comprises a flexible riser 201, a platform 202 and a test location 203. The annulus testing of the flexible riser 201 is typically performed at test location 203.

As per today the annulus testing is typically performed manually, which requires specially trained personnel offshore to perform the test procedure. Thus, the testing is costly and prone to human errors and variations. Limited availability of specially trained personnel can also result in integrity tests not being performed as frequent as intended or according to schedule.

Systems for automatic measurement of annulus volumes of flexible pipes exist. These systems are limited in functionality by not being portable due to physical and

installation characteristics. These systems are designed for permanent installation and for monitoring of a dedicated riser, i.e. the systems are not portable.

The duration of the annulus test has correlation with the differential pressure in riser annulus during testing. If a more accurate test method is present, the differential pressure can be lowered, thus reducing test duration. The manually performed annulus test normally requires a relatively long test duration to compensate for low data analysis capability and accuracy.

SUMMARY OF THE INVENTION

According to the present invention, the above mentioned problems are solved by an arrangement for portable and automatic determination of a pipe's annulus volume.

The arrangement is portable, by the meaning of one or more unit(s) that can be transported with ease to the desired location, and requires only simple mounting. This is made possible by fitting the entire arrangement for automatic annulus testing into one or more portable unit(s).

The arrangement consists of at least one logical unit for controlling at least one valve, reading pressure from at least one pressure instrument and calculating at least one annulus volume. However, it is possible in some embodiments to control one or more of the arrangement components manually. The arrangement further consists of at least one instrument for measuring amount of gas added or removed from the pipe annulus.

The arrangement is connected to the pipe annulus, and introduces a pressure difference in the annulus. The arrangement calculates the annulus volume based on the introduced pressure difference in pipe annulus and the amount of gas which is removed or added in the annulus.

FIGURE DESCRIPTION

Figure 1 shows the cross section of a flexible pipe.

Figure 2 shows an example of an offshore installation which comprises a flexible pipe, in this case a flexible riser.
Figure 3 shows an arrangement for automated portable annulus testing and / or monitoring of the integrity of at least one annulus volume.

All figures are schematic and not to scale, and they show only the parts necessary to illustrate the invention, other parts are omitted or merely indicated.

INVENTION DESCRIPTION

The solution according to the present invention is achieved by an arrangement in accordance to the characterizing part of the independent claim.

The present invention is related to an arrangement for portable and automatic determination of a flexible pipe's annulus volume. The annulus testing is performed by use of a logic unit which controls the sequence of opening and closing at least one valve, and based on acquired pressure readings, calculates the annulus volume.

The arrangement typically comprises, not limited by, the components inside container 308 in figure 3; at least one flow arrangement 305 for flow measurement, at least one valve 304 connected to at least one annulus volume 301 and the at least one flow arrangement 305 for pressurization and / or depressurization of the annulus volume 301, at least one pressure instrument 303 for pressure measurement of the annulus volume 301, where a logic unit 307 is arranged to read off at least one pressure instrument 303, read off and control at least one valve 304 and read off at least one flow arrangement 305, and calculate the annulus volume 301 based on pressure measurement and flow measurements, all components fitted into at least one portable unit.

If the system is fully automated, the arrangement will automatically perform the annulus volume test when the system is connected, and test sequence is initiated.

The portable arrangement 308 can measure annulus volume 301 using a gas feed or using diffused gas to achieve a pressure build-up in the riser annulus 301. Alternatively, the portable arrangement 308 can measure annulus volume 301 using vacuum. Gas is then removed from riser annulus 301 by introducing a sub-atmospheric pressure in the riser annulus 301.

In a preferable embodiment of the present invention the arrangement 308 is fitted into one portable unit. However, it is possible in some embodiments to divide the components inside arrangement 308 into more portable units.

Also, in a preferable embodiment of the present invention the arrangement 308 is controlled by use of a logical unit 307. However, it is possible in some embodiments to control one or more of the arrangement 308 components manually.

In another embodiment of the present invention, the portable arrangement can be used for flow rate measurement of the diffused gas from the annulus volume 301.

In another embodiment of the present invention, the portable arrangement 308 calculates the annulus volume 301 and shows the result on a display connected to the logical unit 307.

C L A I M S

1. An arrangement for determination of annulus volume (301) in a pipe, c h a r a c t h e r i z e d b y that the arrangement (308) comprises, not limited by, the following:
   - at least one flow arrangement (305) for gas flow measurement,
   - at least one valve (304) connected to at least one annulus volume (301) and the flow arrangement (305) for pressurization and / or depressurization of the annulus volume (301),
   - at least one pressure instrument (303) for pressure measurement of the annulus volume (301),
   - at least one logic unit (307) is arranged to read off at least one pressure instrument (303), read off and control at least one valve (304) and read off at least one flow arrangement (305) and calculation of annulus volume (301) based on pressure and flow measurements,
   - the logical unit (307) can control one or more of the arrangement components,
   - placed into at least one portable unit.
2. Arrangement according to claim 1, where the pressure instrument (303) is connected in-between valve (304) and annulus volume (301).
3. Arrangement according to claims 1 – 2, where it is indifferent where the flow arrangement (305) is positioned in line with gas flow direction between annulus volume (301) and outlet/inlet (306) or after outlet/inlet (306).
4. Arrangement according to claims 1 – 3, where the components inside arrangement (308) can be fitted into one or more portable unit(s).
5. Arrangement according to claims 1 – 4, where the portable arrangement (308) can measure annulus volume (301) using a gas feed or using diffused gas to increase the pressure in riser annulus.
6. Arrangement according to claims 1 – 4, where the portable arrangement (308) can measure annulus volume (301) using vacuum to lower the pressure in riser annulus.
7. Arrangement according to claims 1 – 6, where the portable arrangement (308) calculates the annulus volume (301) and shows the result on a display connected to the logical unit (307).

8. Arrangement according to claims 1 – 7, where the portable arrangement (308) is used for flow rate measurement of the diffused gas from the annulus volume (301).

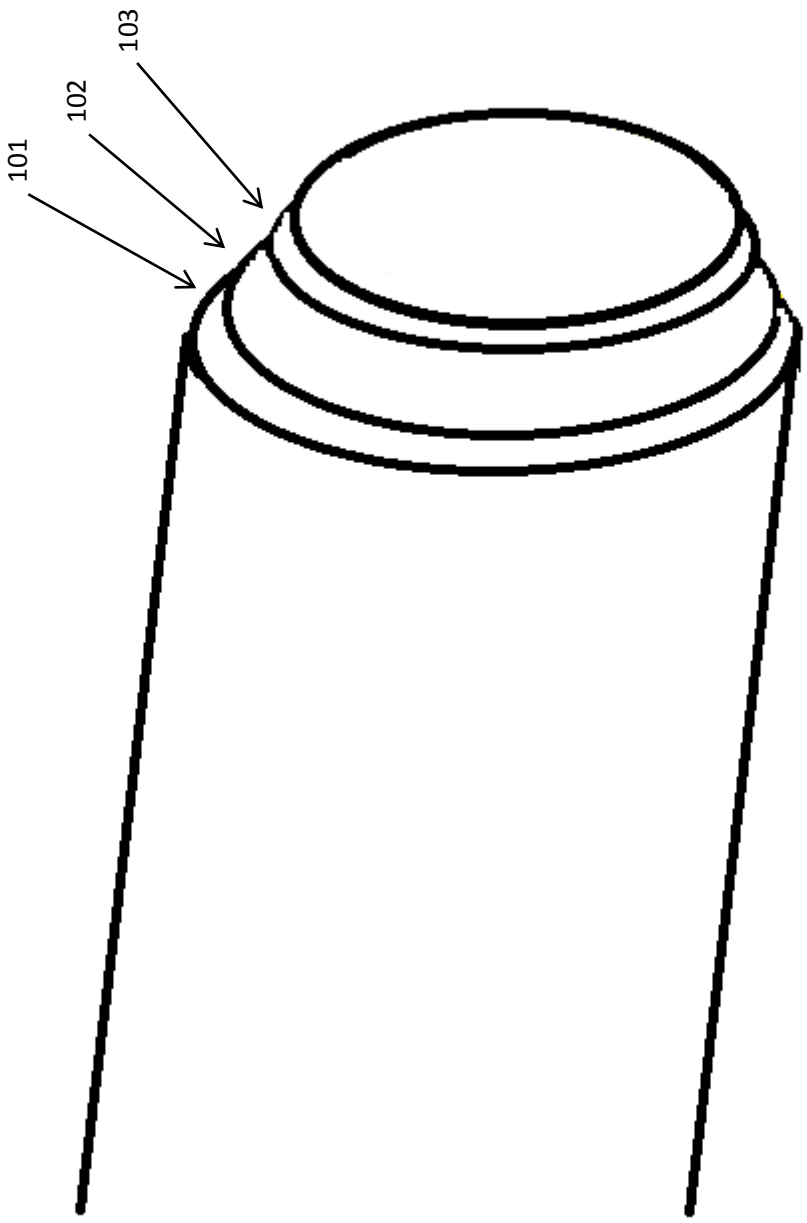


Figure 1

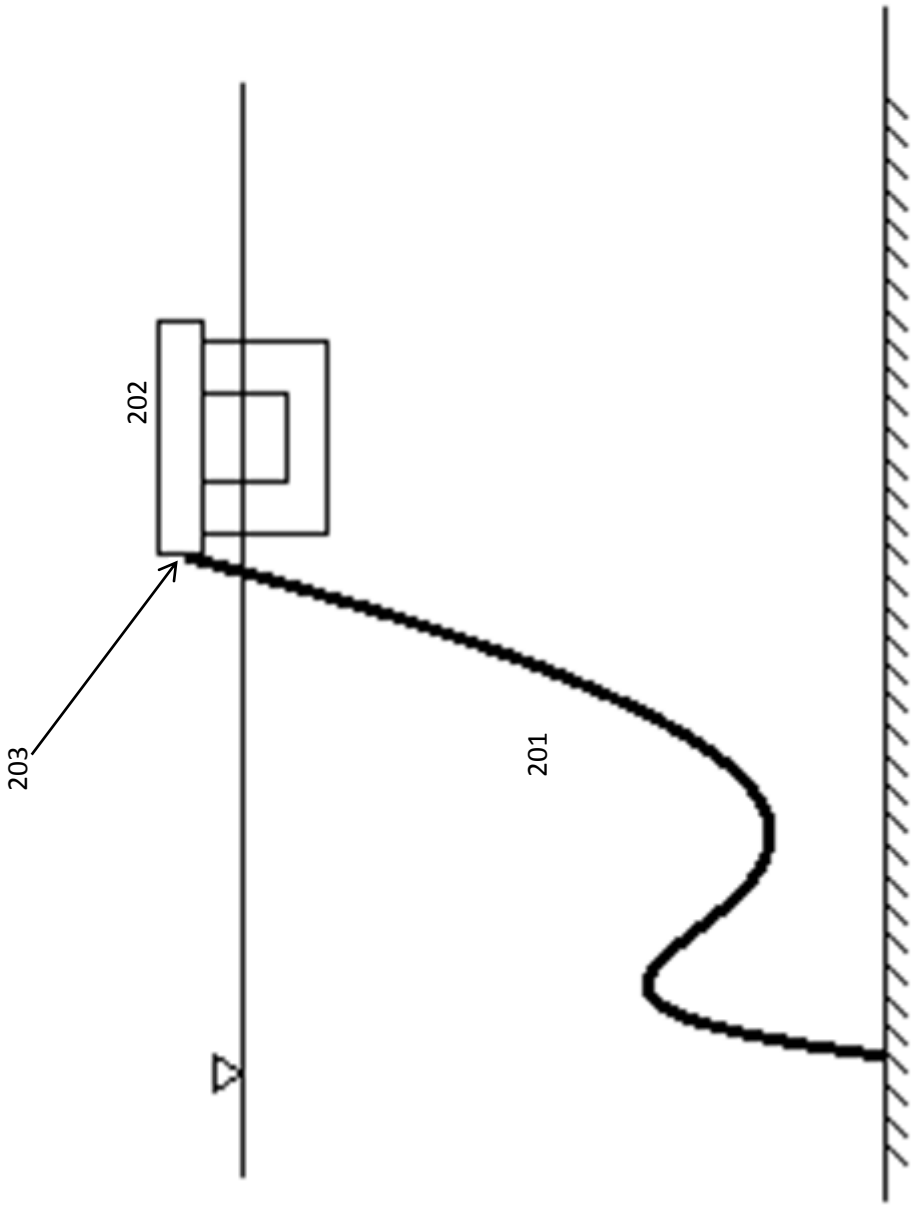


Figure 2

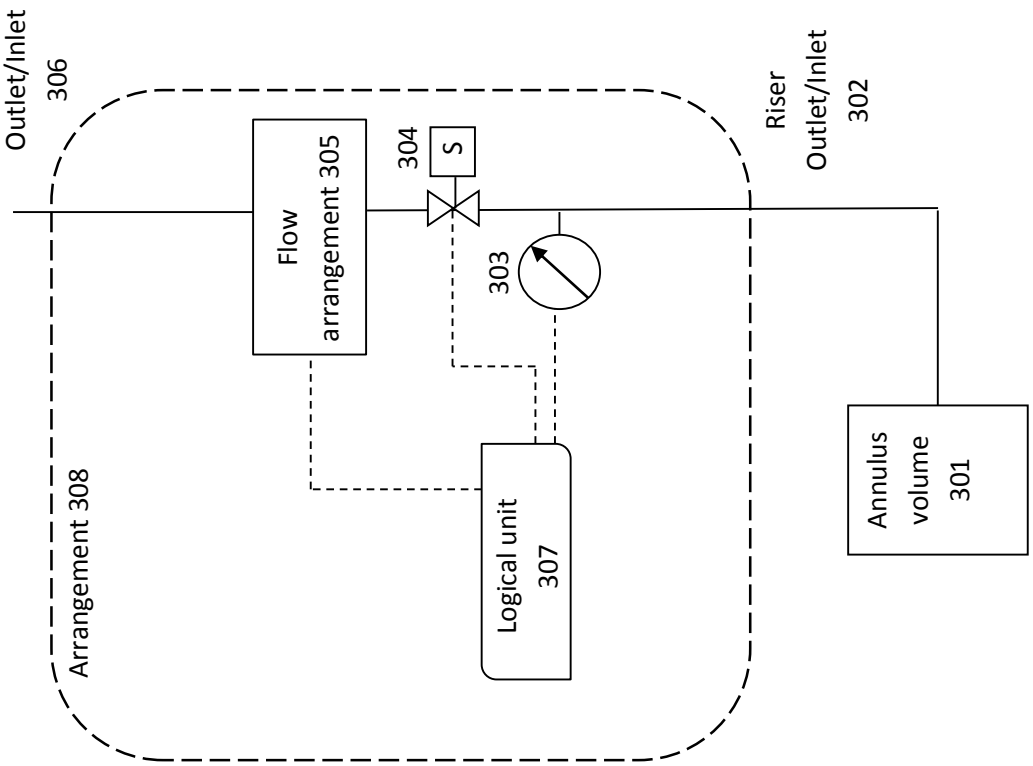

Outlet/Inlet
306
Arrangement 308
Flow
arrangement 305
304
S
303
Logical unit
307
Riser
Outlet/Inlet
302
Annulus
volume
301

Figure 3