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CA 2370232 C 2009/07/14

(11)(21) 2 370 232

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2000/04/28
(87) Date publication PCT/PCT Publication Date: 2000/11/09
(45) Date de délivrance/Issue Date: 2009/07/14
(85) Entrée phase nationale/National Entry: 2001/10/22
(86) N° demande PCT/PCT Application No.: GB 2000/001660
(87) N° publication PCT/PCT Publication No.: 2000/067018
(30) Priorité/Priority: 1999/04/30 (GB9910160.2)

(51) Cl.Int./Int.Cl. *G01F 1/74* (2006.01), *G01N 33/28* (2006.01), *G01N 35/00* (2006.01)

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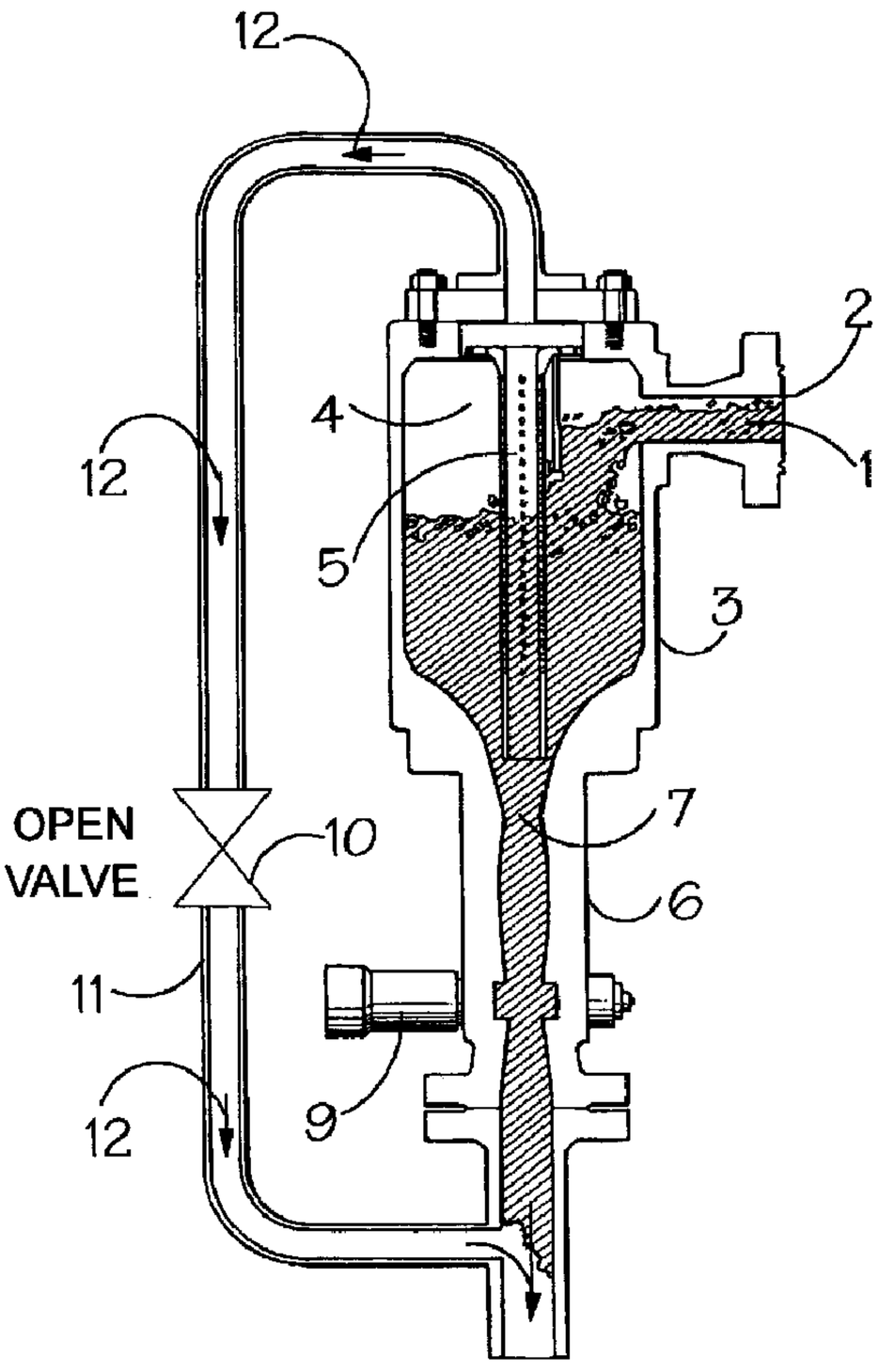
(54) Titre : SYSTEME DE MESURES AMELIOREES DU RAPPORT EAU-HUILE
(54) Title: ARRANGEMENT FOR IMPROVED WATER-OIL RATIO MEASUREMENTS



(57) Abrégé/Abstract:
A method of, and apparatus for measuring the relative proportions of oil and water in a flowing multiphase fluid comprising allowing the gas, oil and water phases of the multiphase fluid at least partially to separate, diverting at least some of the separated gas phase

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(57) Abrégé(suite)/Abstract(continued):
from the flowing fluid, into a bypass conduit, through a separating module, such as the tank of a homogenising unit, wherein the gas phase tends to separate and collect above a pool of fluid, and measuring the relative proportions of oil and water in the undiverted fluid. A valve is located in the bypass conduit which has an inlet leading from the upper section of the tank (where gas collects) and an outlet joining the outlet pipe leading from the homogenising unit downstream of metering apparatus.

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WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 :
G01N 33/28, G01F 15/08

A1

(11) International Publication Number: **WO 00/67018**

(43) International Publication Date: 9 November 2000 (09.11.00)

(21) International Application Number: PCT/GB00/01660

(22) International Filing Date: 28 April 2000 (28.04.00)

(30) Priority Data:
9910160.2 30 April 1999 (30.04.99) GB

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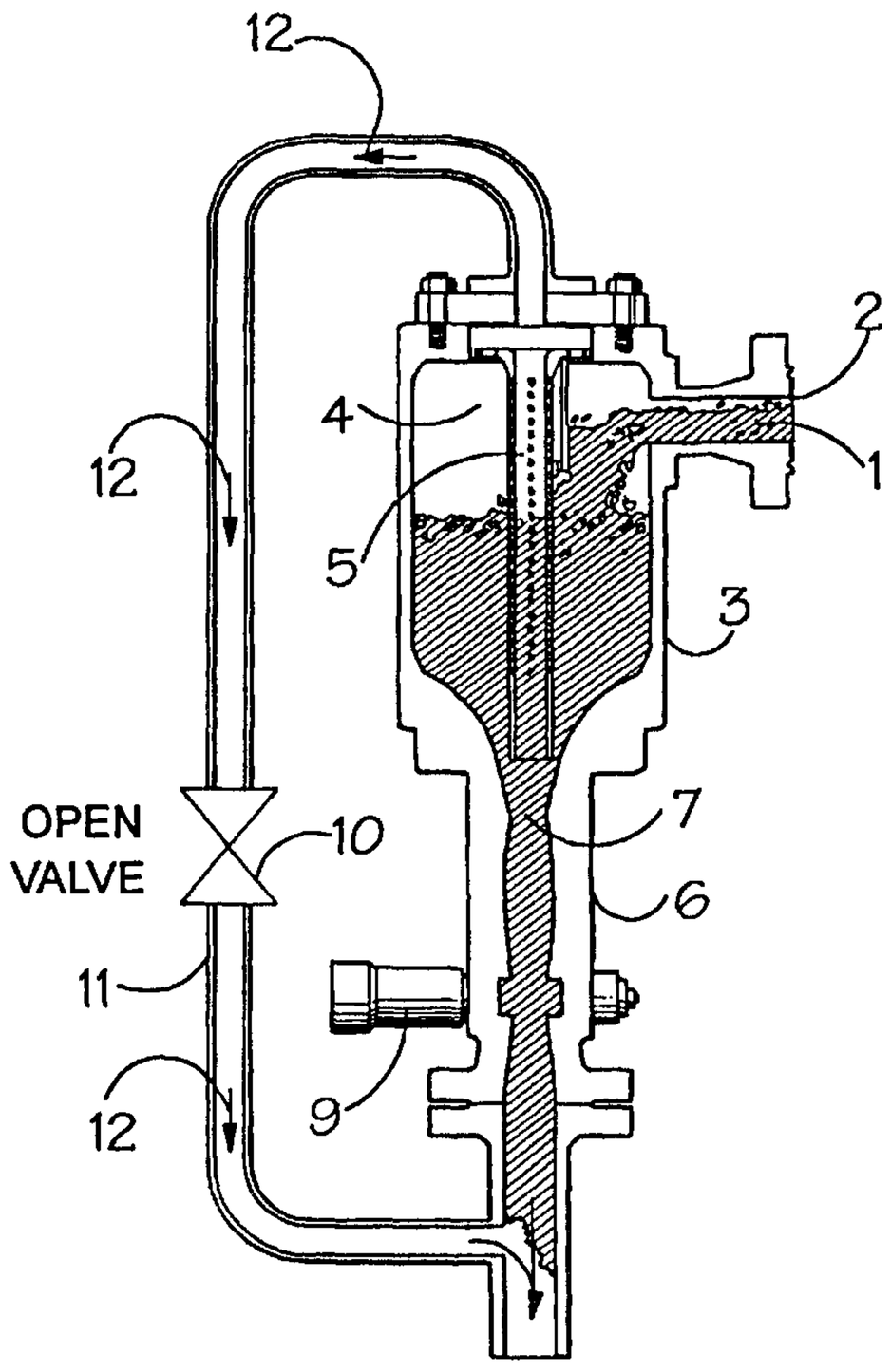
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: ARRANGEMENT FOR IMPROVED WATER–OIL RATIO MEASUREMENTS

(57) Abstract

A method of, and apparatus for measuring the relative proportions of oil and water in a flowing multiphase fluid comprising allowing the gas, oil and water phases of the multiphase fluid at least partially to separate, diverting at least some of the separated gas phase from the flowing fluid, into a bypass conduit, through a separating module, such as the tank of a homogenising unit, wherein the gas phase tends to separate and collect above a pool of fluid, and measuring the relative proportions of oil and water in the undiverted fluid. A valve is located in the bypass conduit which has an inlet leading from the upper section of the tank (where gas collects) and an outlet joining the outlet pipe leading from the homogenising unit downstream of metering apparatus.



ARRANGEMENT FOR IMPROVED WATER-OIL RATIO MEASUREMENTS

DESCRIPTION

The present invention relates to apparatus and method for fluid measurement and is particularly applicable to the measurement of individual proportions of the component phases of a multiphase fluid.

It is particularly useful in the field of fluid flow from oil and gas wells. The fluid flowing from a well generally comprises a mixture of oil, gas and water and it can be of great advantage to measure the individual phases without first having to separate them.

This has been done using apparatus as disclosed in EP-A-0 424 503. The relative amount of water and oil is often critical but unfortunately inherently difficult to measure accurately when there is a large amount of gas in the mixture.

The present invention seeks to improve the accuracy of fluid flow measurements.

According to the present invention there is provided a method of measuring the relative proportions of oil and water in a flowing multiphase fluid, the method comprising allowing the gas, oil and water phases of the multiphase fluid at least partially to separate, diverting at least some of the separated gas phase from the flowing fluid, into a bypass conduit, measuring the relative proportions of oil

and water in the undiverted fluid.

Preferably the multiphase fluid is directed to flow through a separating module wherein the gas phase tends to separate and collect above a pool of fluid.

In a particularly preferred embodiment such a separating module comprises the tank of a homogenising unit. Such as is described in EP-A-0 379 319. The bypass conduit is then constructed with an inlet leading from the upper section of the tank (where gas collects) and an outlet joining the outlet pipe leading from the homogeniser, downstream of metering apparatus. A valve is located in the bypass conduit.

The valve may be manually or automatically operated, for example based on a pre-programmed metering cycle. The valve may be a choke or alternatively arranged to allow a flow rate for the bypassing gas phase appropriate to the pressure drop monitored by the multiphase flow meter located in the outlet pipe from the homogenising unit.

The valve will be kept closed for normal operation, but will be opened periodically for the performance of high quality water-oil ratio measurements. Normally the water-oil ratio does not vary dramatically over short periods of time. The high quality measurement made using the method of the present invention can be compared to normal measurements for improved accuracy or to update calibration values or parameters.

The valve may also be remotely operated.

The method of the invention also allows in-situ sensor calibration operations to be performed. This is particularly useful for example for sub-sea applications and other permanent installations where there is an unknown mixture in the meter, so that calibration was hitherto very difficult.

Using the method of the invention, calibration can be effected at two different conditions, such as two different gas volume fractions, for the same production conditions.

No measurement of the fluid in the bypass conduit is necessary and it is not necessary to ensure that only the gas phase is diverted; spillover of liquid phase will not affect operation of the invention.

Apparatus for performing the method is also provided.

Thus the invention provides a very versatile method of increasing the accuracy of fluid flow measurements on multiphase fluids.

For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made to the accompanying drawings in which:

Figure 1 is a cross-sectional view of apparatus embodying the invention with a closed valve.

Figure 2 is a cross-sectional view of apparatus embodying the invention with an open valve.

Figure 1 illustrates the normal mode of operation of the apparatus. Multiphase fluid 1 enters through inlet conduit 2 and partially fills a chamber 3. The fluid 1 has a tendency to separate as it enters and in chamber 3 a gaseous phase occupies the volume 4 of chamber 3 and lies above the fluid 1.

A perforated pipe 5 is positioned generally in the centre of chamber 3 and is coaxial with it. This arrangement serves to assist homogenisation of the multiphase fluid. The liquid phase in the bottom of chamber 3 enters pipe 5 through the lower perforations and also flows out of chamber 3 directly through outlet pipe 6 in which a restriction or venturi 7 is positioned. The gaseous phase lying above the liquid phase is drawn into the top of the pipe 5 as shown by arrows 8 and also through the upper perforations of the pipe 5 by the suction effect created by the flowing fluid phase particularly by the venturi effect in the restriction 7.

A meter 9 in the outlet conduit 6 measures flow rates and proportions of oil to water in the out-flowing fluid. With valve 10 closed there is no flow of gas or liquid or any combination, through bypass pipe 11.

However as shown in Figure 2, under certain circumstances the valve 10 is opened, allowing gaseous phase to flow through the bypass pipe 11 as shown by arrows 12.

Thus less gaseous phase is present in the fluid flowing through meter 9 and the measurements of proportions of oil to water will be inherently more accurate than hitherto possible.

In many practical applications the gas phase may account for 95% or more of the multiphase mixture. Consider for example a meter with an inherent error margin of ± 0.5%. If the water-oil ratio is measured at 3:1 and the gas is 96% the meter inherent inaccuracy means that the oil component (which accounts for only 1% of the total mixture) will be measured with a relative uncertainty of ±50% which is evidently somewhat unsatisfactory.

The present invention allows the proportion of gas in the mixture to be reduced temporarily and continuously while a measurement is made and to be re-introduced into the fluid flowing through the apparatus after the measurement is made.

Thus for example, the gas phase may be reduced, via the bypass, to 60%. If the water-oil ratio is again measured at 3:1 then this time the oil is 10% of the total and thus with an inherent meter error margin of ±0.5% the oil component will be measured with a relative uncertainty of 5%.

Evidently better accuracies are achieved if the gas is reduced more.

The opening times and durations of valve 10 may be controlled directly or in response to signals from the meter 9 or alternatively manually.

The meter 9 may be a composition meter such as the known dual energy gamma meter or the known total flow rate or momentum flux meter such as a venturi meter.

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CLAIMS

1. A method of measuring the relative proportions of oil and water in a flowing multiphase fluid (1), the method comprising allowing the gas, oil and water phases of the multiphase fluid (1) at least partially to separate, diverting at least some of the separated gas phase (4) from the flowing fluid (1), into a bypass conduit (11), and measuring the relative proportions of oil and water in the undiverted fluid wherein the multiphase fluid (1) is directed to flow through a separating module wherein the gas phase (4) tends to separate and collect above a pool of fluid and wherein the separating module comprises a tank of a homogenizing unit (3), which comprises a perforated pipe (5) to assist homogenization of the multiphase fluid.

2. A method according claim 1 wherein the bypass conduit comprises an inlet leading from the upper section of the tank, where gas collects, and an outlet joining the outlet pipe leading from the homogenizing unit (3).

3. A method according to claim 2 wherein the outlet is downstream of metering apparatus.

4. A method according to any one of claims 1 to 3 wherein a valve (10) is located in the bypass conduit (11).

5. A method according to claim 4 wherein the valve (10) is manually operated.

6. A method according to claim 4 wherein the valve (10) is automatically operated.

7. A method according to claim 6 wherein the valve (10) is operated depending on a pro-programmed metering cycle.

8. A method according to any one of claims 4 to 7, wherein the valve (10) is a choke.

9. A method according to any one of claims 4 to 6 or to claim 7 when dependent on claim 2, wherein the valve (10) is arranged to allow a flow rate for the bypassing gas phase appropriate to the pressure drop monitored by the multiphase flow meter located in the outlet pipe from the homogenizing unit (3).

10. A method according to any one of claims 4 to 9 wherein the valve (10) is kept closed for normal operation.

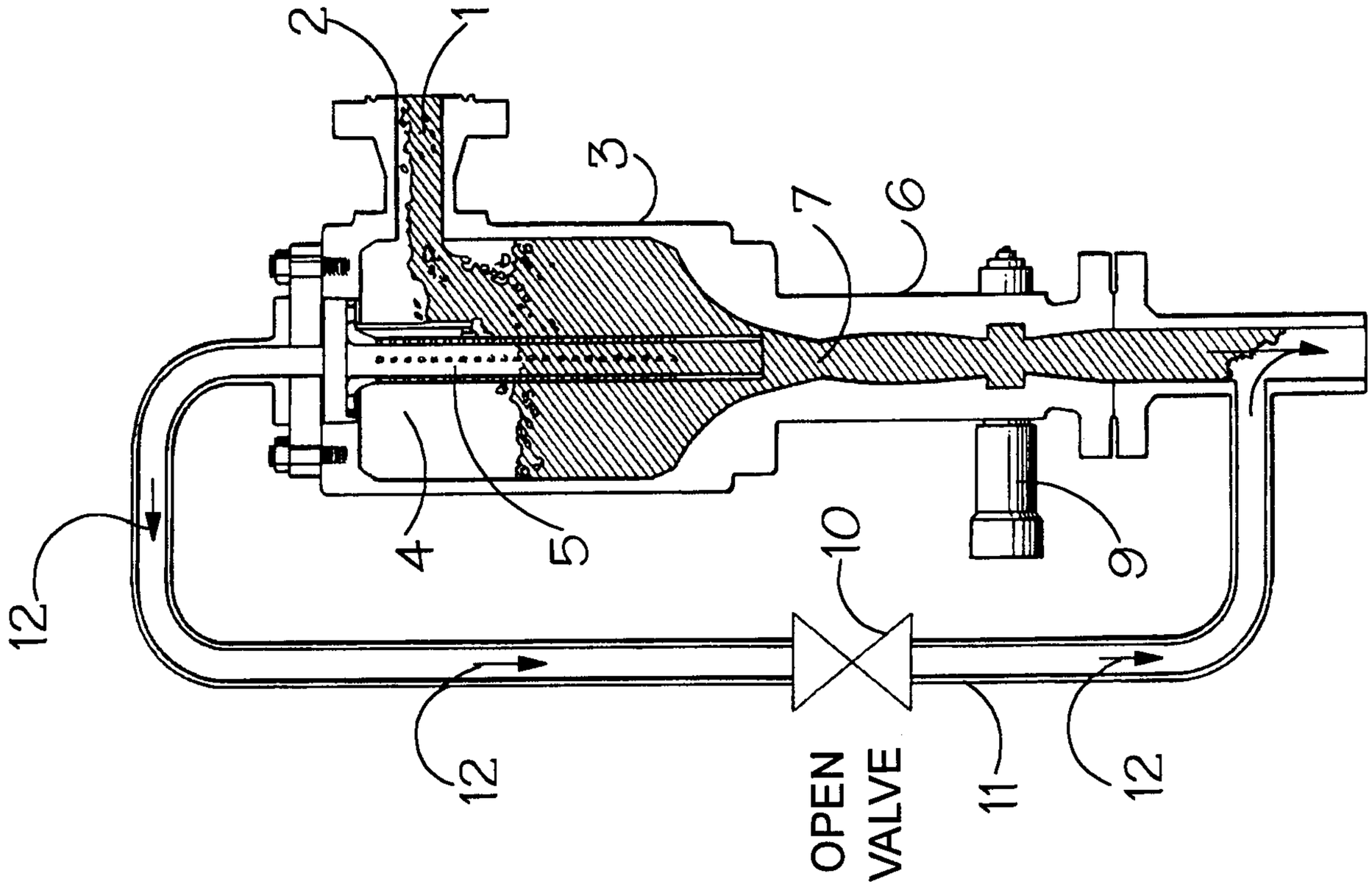
11. A method according to claim 4 wherein the valve (10) is remotely operated.

12. A method according to any one of claims 1 to 11 when used for in-situ sensor calibration operations.

13. A method according to any one of claims 1 to 12 when used for calibration at two different conditions for the same production conditions.

14. A method according to claim 13 when the two different conditions comprise two different gas volume fractions.

15. Apparatus for measuring the relative proportions of oil and water in a flowing multiphase fluid, the apparatus comprising a separating module wherein the gas phase (4) tends to separate and collect above a pool of fluid, the separating module comprising a tank of a homogenizing unit (3) which comprises a perforated pipe (5) to assist homogenization of the multiphase fluid, a bypass conduit (11) for diverting at least some of the separated gas phase, and means for measuring the relative proportions of oil and water in the undiverted fluid.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OPEN VALVE
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FIG.2.

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CLOSED VALVE
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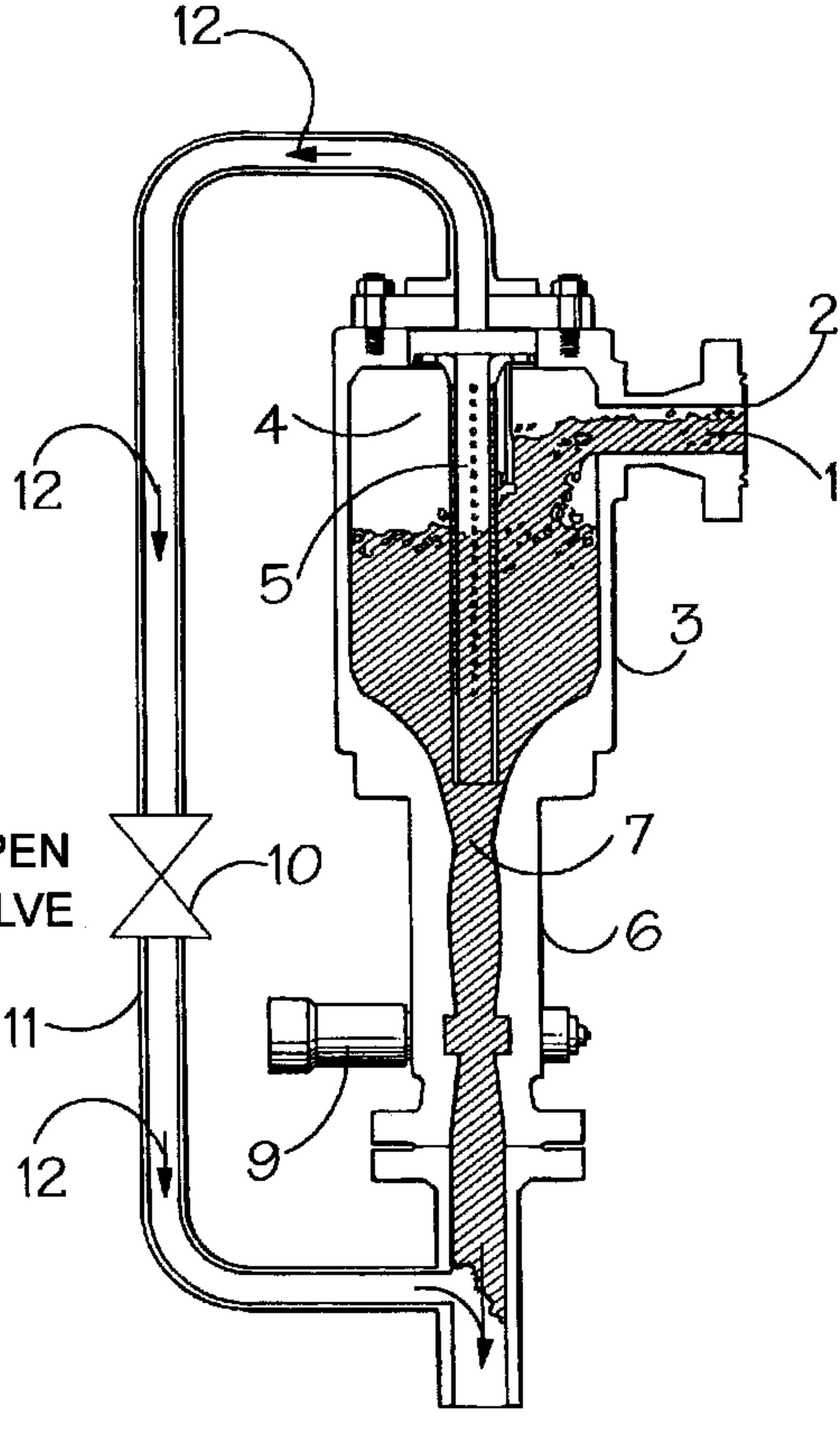
FIG.1.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VALVE
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