(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 July 2013 (04.07.20 13)

WIPO | PCT

(10) International Publication Number
WO 2013/100775 Al

(51) International Patent Classification:
BOW 17/02 (2006.01) *BOID 17/04* (2006.01)
BOW 15/02 (2006.01)

(21) International Application Number:
PCT/RU201 1/001026

(22) International Filing Date:
27 December 201 1 (27. 12.201 1)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US):* **SIEMENS AKTIENGESELLSCHAFT** [DE/DE]; Wittelsbacherplatz 2, 80333 Muenchen (DE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only):* **MALININ, Vitaly Vladimirovich** [RU/RU]; Marshal Konev str.16, appt.57, Moscow, 123060 (RU).

(74) Agents: **MITS, Alexander Vladimirovich** et al; Law Firm "Gorodissky & Partners" LTD, Bolshaya Spasskaya str., 25, bldg .3, Moscow, 129090 (RU).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

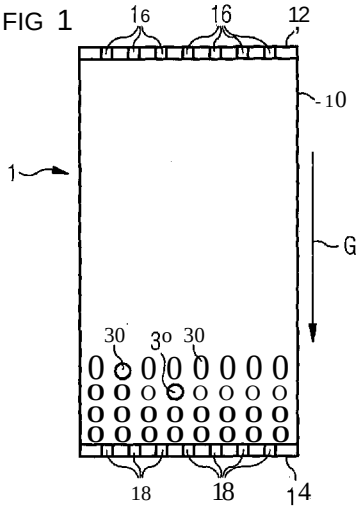
Published:

— *with international search report (Art. 21(3))*

WO 2013/100775 A1

(54) Title: COALESCENCE FILTER

FIG 1



(57) Abstract: The invention refers to a coalescence filter (1) for separating a phase from a mixture of an immiscible liquid (emulsion), comprising a chamber (10) which is filled with collector particles (30) and through which chamber (30) the immiscible liquid flows. The material of the collector particles (30) is selected from a material so that the phase to be separated from the immiscible liquid wets the surface of the collector particles (30). The collector particles (30) have a specific weight and/or shape so that their direction of travel within the chamber is dependent from the amount of phase being attached to the collector particles (30). Furthermore, the chamber (10) is made such that collector particles (30) which have gathered or absorbed a sufficient amount of phase to be separated from the liquid will be discharged upon contact with the chamber (10) such that the gathered phase can be released from the chamber (10) so that the cleaned collector particles (30) change their direction of travel resulting in a circulation of the collector particles (30).

COALESCENCE FILTER

DESCRIPTION

The invention relates to a coalescence filter for separating a phase from a mixture of an immiscible liquid, comprising a chamber which is filled with collector particles and through which the immiscible liquid flows.

Mixtures of immiscible liquids are called emulsion. There are a lot of industrial processes encountering the problem of phases' separation from emulsions. For example, the saturation of water-in-oil or oil-in-water emulsions has become industrially important due to increased demands on oil-recovery rates and energy consumption reasons. For example, by the presence of water droplets in liquid fuels corrosion may be caused.

There are so-called primary emulsions with drop sizes greater than 100 microns and so-called secondary emulsions with drop sizes less than 100 microns. The separation of primary emulsions is often accomplished by gravity settling or cyclones. In case of tiny droplets of secondary emulsions with large surface volume ratio standard approaches as named above are not effective. The matter is that so small droplets are completely entrained by main fluid flow of the emulsion. In order to separate secondary emulsions additionally techniques are developed for preliminary coalescence of tiny droplets to larger ones. Coalescence significantly increase droplets' dimensions and make standard separation techniques more efficient.

A general problem of coalescent filters is that the deposition of the sediments and the accumulation of insoluble impurities that results in a filter contamination. This problem can be solved either by replacement of contaminated filter by a clean one or a mechanical cleaning of the filter during operation. However, these methods demand either additional actuators to drive cleaning equipment or supply of compressed air or other chemical reactions.

EP 0 148 444 A2 discloses a coalescence filter for separating a phase of an immiscible liquid. In this filter a pre-purified mixture is introduced from below through a perforated plate into the coalescence chamber which contains a multiplicity of coalescence bodies which consist of an oilphilic plastic and are lighter than water. Fine oil particles settle on the oilphilic surface of these bodies, coalesce on the bodies and rise as larger oil droplets, which can easily be separated of, into the separation chamber

where they are collect in an oil collection space from which they can be removed.

However, this filter suffers from saturation phenomena. The phase to be separated steadily accumulates on collecting surfaces of the coalescence bodies and remains therefore a sufficient amount of time. Such filter overloading results in an overall decrease of filtration efficiency. This problem can be solved by increase of pressure drop or decrease of mixture flow rate.

It is therefore an object of the present invention to provide an improved coalescence filter which does not suffer from saturation phenomena.

This object is solved by a coalescence filter according to claim 1. Preferred embodiments are set out in the dependent claims.

The invention provides a coalescence filter for separating a phase from a mixture of an immiscible liquid, comprising a chamber which is filled with collector particles and through which chamber the immiscible liquid flows. The material of the collector particles is selected from a material so that the phase to be separated from the immiscible liquids wets a surface of the collector particles. The collector particles have a specific weight and/or shape so that their direction of travel within the chamber is dependent from the amount of phase being attached to the collector particles. The chamber is made such that collector particles which have gathered or absorbed a sufficient amount of phase to be separated from the liquid will be discharged upon contact with the chamber such that a gathered phase can be released from the chamber so that the collector particles change their direction of travel resulting in a circulation of the collector particles.

The coalescence filter according to the invention is self-cleaning so that it does not suffer from saturation or contamination due to permanent circulation of the collector particles within the chamber. Due to the permanent circulation of the collector particles permanent collisions of the collector particles with the walls of the chamber and other particles will occur. Therefore, contamination (i.e. sediments deposition or insoluble impurities accumulation) can be avoided. As a result, there is no need in filter cleaning procedure during the whole operation lifetime. The coalescence filter allows separating any types of immiscible fluids, i.e. emulsions.

The collector particles having no wetted surface move against the direction of the immiscible liquid flow. Collector particles having no wetted surface are, for example,

particles where the phase is released because of the contact of the particles with the chamber or particles being clean for other reasons. On the other hand, the collector particles having a surface being saturated or wetted with sufficient amount of the phase to be separated move in the direction of the immiscible liquid flow.

There are two possible situations which can occur. First, a separation of droplets of a denser phase than the main carrying fluid (i.e. the emulsion and immiscible liquid, respectively) has to be made or, second, vice versa. In accordance to the two cases two different filter arrangements have to be chosen:

1. If droplets of lighter phase than the main carrying fluid have to be separated from the emulsion, the fluid flow is directed upward, i.e. opposite to the direction of gravity, and the collector particles have a negative floatage in respect to main carrying fluid as long as they are not saturated or wetted with sufficient amount of the phase to be separated.

2. If droplets of denser phase than the main carrying fluid have to be separated, the fluid flow is directed downwards, i.e. in direction of gravity, and the collector particles have a positive floatage in respect to the main carrying fluid as they are not saturated or wetted with sufficient amount of the phase to be separated.

According to a preferred embodiment, the chamber of the coalescence filter comprises an inlet plate having a first number of perforations and being located at a first end of the chamber and an outlet plate having a second number of perforations and being located at a second end of the chamber, wherein the second end is located opposite to the first end of the chamber. The flow of the immiscible liquid flows into the chamber at the inlet plate and droplets of the released/separated phase and the refined liquid are diverted from the chamber at the outlet plate.

Preferably, the chamber has the shape of a cylinder being vertically aligned such that the immiscible liquid flows through the inlet and the outlet plate. It is to be understood that the geometry of the chamber may differ as long as this geometry allows to organize stable circulation of the flow of the liquid. In particular, the flow direction is parallel to a gravity force vector. Generally, the flow direction depends on the properties of the phase to be separated.

According to a further embodiment, the outlet plate has a surface which enables discharging the phase to be separated from the surface of the wetted collector particles

when having contacted the outlet plate. The surface of the outlet plate may be structured or made from a material which supports discharging the phase to be separated from the surface of the wetted collector particles. Depending on the collector material which may be hydrophilic or oilphilic (in general wettable or non-wettable for the phase to be separated from the immiscible liquid), the material of the outlet plate may be hydrophilic or oilphilic, too.

The inlet plate and/or the outlet plate comprise at least one region being non-perforated for forcing the recirculation of the collector particles. In a preferred embodiment, it is sufficient, if the inlet plate has one or more non-perforated regions. The non-perforated regions of the inlet plate and/or the outlet plate support and force, respectively, the recirculation of the collector particles so that they have permanent collisions with the walls of the chamber or other particles. Such, the self-cleaning effect is improved. The non-perforated regions stabilize the flow of the immiscible liquid and its recirculation. The non-perforated regions help initiating recirculation of the flow. Furthermore, recirculation will be supported by particles moving themselves.

The non-perforated region or regions may be in the center of the inlet and/or outlet plate. Alternatively or additionally, the non-perforated region or regions may be in the circumferential of the inlet and/or outlet plate.

According to the composition of the immiscible liquid and the phase to be separated from the liquid the material of the collector particles may be wettable or non-wettable for the phase to be separated from the immiscible liquid. In particular the material may be hydrophilic or oilphilic.

According to a further embodiment, the collector material located within the chamber may have a diameter being greater than that of the first and the second number of perforations to ensure that the collector particles remain within the chamber.

The invention will be described hereinafter in more detail by reference to the accompanying figures.

Fig. 1 shows a coalescence filter according to the invention.

Fig. 2 shows a top view of a first embodiment of an inlet plate and/or an outlet plate of the coalescence filter in Fig. 1.

Fig. 3 shows a top view of a second embodiment of an inlet plate and/or an outlet plate of the coalescence filter in Fig. 1.

Fig. 4 illustrates the coalescence filter operation for separating a phase which is lighter than the main carrying fluid.

Fig. 5 illustrates a coalescence filter operation for separating a phase which is denser than the main carrying fluid.

Referring to Fig. 1 a coalescence filter 1 consists of a vertically aligned cylindrical chamber 10 which is filled with collector particles 30. "Vertically aligned" means that the orientation of the chamber 10 is substantially parallel to a gravity field vector G. The shape of the chamber 10 in cross section does not necessarily have to have the shape of a circle. In cross section the chamber 10 could have any other suitable shape. A suitable shape is favourable for stable recirculation zones existence which will be explained later on.

The collector particles 30 are, for example, hydrophilic or hydrophobic spherical particles of an arbitrary diameter. The diameter depends on operational conditions as will be explained later on. The material of the collector particles 30 depends on the phase to be separated from an immiscible liquid flowing parallel to the gravity force vector G through the chamber 10. Therefore, in general, the material is wettable or non-wettable for the phase to be separated from the immiscible liquid.

From the top and the bottom the chamber 10 is sealed with perforated plates 12, 14. One of them is acting as an inlet plate, the other as an outlet plate. The number of perforations of plate 12 is depicted with 16. The number of perforations of plate 14 is depicted with reference numeral 18. The number of perforations 16 of the inlet plate 12 and the number of perforations 18 of the outlet plate 14 may be identical. However, this is not necessary. The shape and size, respectively, of the perforations 16, 18 is such that their diameter is smaller than the diameter of the collector particles 30. As a result, the perforated plates 12, 14 which enclose the chamber 10 at their opposite ends restrict the collector particles from escaping the container.

Figures 2 and 3 show possible embodiments of the shape and geometry, respectively, of the perforated plates 12, 14. It is to be understood that the plates 12, 14 may have the same shape and geometry, but it also is possible that shape and geometry of plates 12 and 14 differ. While the embodiment in Fig. 2 has an outer non-perforated region 20, the embodiment in Fig. 3 has an inner, central non-perforated region 22. The non-perforated region 20, 22 as illustrated in figures 2 and 3 improves forcing a

recirculation process of the collector particles 30 as will be explained below.

The principle operation of the coalescence filter 1 is based on a selected wetting of the phase to be separated on the surface of the collector particles 30. For example, in case of oil to be separated from a water-oil-emulsion the collector particles 30 should be made of hydrophobic or oilphilic material. In the opposite case of water to be separated from an oil-water-emulsion, the collector particles 13 should be hydrophilic or oilphobic.

In both cases, there are two possible situations. In the first situation droplets of the lighter phase have to be separated from the main carrying fluid, i.e. the emulsion. In this situation the fluid flow FI is directed upward and the collector particles 30 have a negative floatage in respect to the main carrying fluid (emulsion). A negative floatage means that such a particle has a greater than carrying fluid density and tends to sink down in steady fluid. This situation is illustrated in Fig. 4, where plate 12 acts as a fluid inlet plate and plate 14 acts as an outlet plate of the coalescence filter 1. Characterizing for this situation is that the fluid flow FI is in the opposite direction to the gravity field vector G.

In the second situation (illustrated in Fig. 5) droplets of denser phase than the main carrying fluid have to be separated. In this situation the fluid flow FI is directed downwards, i.e. in the direction of the gravity field vector G. The collector particles 30 have a positive floatage in respect to the carrying fluid. A positive floatage means that such a particle has a smaller than carrying fluid density and tends to rise up in steady fluid. In this situation the inlet plate 12 is - with regard to the gravity field vector - at the upper end of the chamber 10 while the outlet plate 14 is at the lower end of chamber 10.

During mixture flow of the emulsion through a collector particle, dispersed phase droplets adsorption occurs at the surface of the collector particles 30. Having reached sufficient "load" of dispersed phase the given sphere (i.e. the surface of the collector particle) is entrained by the fluid flow. In case of the separation of a denser phase than the main carrying fluid the collector particles sink down (Fig. 5). In case of the lighter phase separation they rise up (Fig. 4). After a while the given sphere will get into contact with the outlet plate 14. Having contacted the perforated outlet plate 14 which is the outlet of the coalescence filter, the sphere discharges from the absorbed phase. As

a result the "cleaned" collector particles move in a direction opposite to the main flow direction back to the inlet plate 12. In case of the embodiment of Fig. 4, the cleaned collector particles 32 sink down to the inlet plate 12 at the bottom of the filter 1. In case of the embodiment according to Fig. 5 the cleaned collector particles 32 rise up to the inlet plate 12 at the upper end of the filter 1. Then, dispersed phase droplets adsorption occurs at the surface of the collector particles again. Thus^ a permanent circulation of "clean" (depicted with reference numeral 32) and "loaded" (depicted with reference numeral 34) spherical collector particles is established in the light the chamber 10. As soon as collector particle „load" with phase to be separated reaches some value the particle starts to move with some velocity. In principle further phase accumulation can occur during particle movement to outlet. Particles with sufficient "load" that are moving to the outlet plate 12, 14 are depicted with reference numeral 33 and particles being insufficiently loaded (clean particles) so that they remain more or less static are depicted with reference numeral 32.

The discharging process of the "loaded" collector particles 34 is facilitated by the flow of the emulsion and the proper choice of the surface properties of the outlet plate 14. Preferably, the material of the outlet plate 14 is made from hydrophilic or hydrophobic material depending on the phase to be separated from the mixture. The collected dispersed phase in its turn releases from the outlet plate 14 in the form of large droplets 36 with a diameter close to the perforation holes diameter of the perforation holes 18.

It should be noted that either circulation direction (depicted with reference numeral 40) or initial circulation is determined by the first number of perforations 16 of the inlet plate 12. In case of an inlet plate 12 with a perforated outer (circumferential) region 20 as illustrated in Fig. 2 the central part of the filter 1 is occupied by clean collector particles 30. In case of an inlet plate 12 with a perforated central region 22 as illustrated in Fig. 3, the near-wall region of the filter is occupied by clean collector particles 30.

By selective wetting of collector particles by the phase to be separated the material of the collector particles and its surface properties should be selected depending on dispersed phase properties.

As soon as a circulation 40 of clean and loaded collector particles 30 has been

established, it is possible to control this process by a particle (sphere) recirculation time. This time determines the intensity of absorbed mass transfer from the filter inlet, i.e. the inlet plate 12, to the filter outlet plate 14. Large recirculation times favour filter self-cleaning. Simultaneously, large recirculation time leads to increased absorbed phase "load" per particle and collector saturation. However, collector saturation results in larger pressure drop and subsequent decrease of overall efficiency. The recirculation time is mostly determined by the time required for sufficient „load" adsorption. After "load" release at the outlet plate the particle has significant negative/positive floatage and moves fast enough towards inlet region. This significant clean particle velocity favors intensive particle collisions with walls etc. and subsequent filter cleaning.

The collector particles recirculation time mostly depends on particles flow. Namely negative and positive floatage determines an amount of absorbed dispersed phase sufficient to force spherical collector particle entrainment by the fluid flow.

There are three forces acting simultaneously on the collector particles: Gravitational force, buoyancy force and friction. In case of lighter dispersed phase than carrying fluid adsorption on spherical collector particles an additional gained buoyancy force occurs. Thus, it is useful to apply particles with negative floatage in order to collect a desired amount of dispersed phase. In the opposite case of denser dispersed phase than the carrying fluid, collector particles with a positive floatage should be used to determine a required "load" of adsorbed phase.

The floatage of the collector particles 30 depends on the diameter of the particles and their mass. The larger the diameter of the particle the large the possible "load" per particle is. At the same time the collector particles effective surface also depends on the particle diameter. The smaller the diameter the larger is the efficient surface. An extremum of the collector efficiency for an intermediate range of particle diameters may be calculated.

A permanent circulation of the collector particles 30 occurs in the chamber 10 of the coalescence filter in the presence of a fluid flow. This circulation 40 results in multiple collisions between particles and between particles and the wall of the chamber. During these collisions all sediments and insoluble contaminants are removed from the surface of the collector particle that results in a filter self-cleaning.

The proposed design of the coalescence filter allows the separation of any types

of immiscible fluids. The design does not suffer from separated phase saturation due to a permanent circulation of the collector particles. Furthermore, the design does not suffer from contamination due to permanent collisions of the collector particles with the walls of the chamber and other particles. Hence, there is no need in filter cleaning procedure during the whole operation lifetime.

Resident time of absorbed phase on collector surface is comparable to "clean surface" period of operation. Thus, an adsorption of various contaminants is significantly reduced. The resident time is directly proportional to the total recirculation time. It can vary depending on collector and mixture properties of the fluid. Hence, it is possible to adjust required time to minimize particle contamination.

CLAIMS

1. A coalescence filter (1) for separating a phase from a mixture of an immiscible liquid (emulsion), comprising a chamber (10) which is filled with collector particles (30) and through which chamber (30) the immiscible liquid flows, wherein

- the material of the collector particles (30) is selected from a material so that the phase to be separated from the immiscible liquid wets the surface of the collector particles (30);

- the collector particles (30) have a specific weight and/or shape so that their direction of travel within the chamber is dependent from the amount of phase being attached to the collector particles (30);

- the chamber (10) is made such that collector particles (30) which have gathered or absorbed a sufficient amount of phase to be separated from the liquid will be discharged upon contact with the chamber (10) such that the gathered phase can be released from the chamber (10) so that the collector particles (30) change their direction of travel resulting in a circulation of the collector particles (30).

2. The coalescence filter according to claim 1, wherein the collector particles (30) having no wetted surface move against the direction of the immiscible liquid flow.

3. The coalescence filter according to claim 1 or 2, wherein the collector particles (30) having a surface being saturated or wetted with sufficient amount of the phase to be separated move in the direction of the immiscible liquid flow.

4. The coalescence filter according to one of the preceding claims, wherein the chamber (10) comprises

- an. inlet plate (12) having a first number of perforations (16) and being located at a first end of the chamber (10);

- an outlet plate (14) having a second number of perforations and being located at a second end of the chamber (10);

- wherein the flow of the immiscible liquid flows into the chamber (10) at the inlet plate (12) and droplets of the released/separated phase and the refined liquid are diverted from the chamber (10) at the outlet plate (16).

5. The coalescence filter according to claim 4, wherein the outlet plate (16) has a surface which enables discharging the phase to be separated from the surface of the wetted collector particles (30) when having contacted the outlet plate (16).

6. The coalescence filter according to claim 4 or 5, wherein the inlet plate (12) and/or the outlet plate (16) comprises at least one region (20, 22) being non-perforated for forcing the recirculation of the collector particles (30).

7. The coalescence filter according to claim 6, wherein the non-perforated region (20, 22) is in the centre of the inlet and/or outlet plate (12, 16).

8. The coalescence filter according to claim 6 or 7, wherein the non-perforated region (20, 22) is in the circumferential of the inlet and/or outlet plate (12, 16).

9. The coalescence filter according to one of the preceding claims, wherein the material of the collector particles (30) is wettable or non-wettable for the phase to be separated from the immiscible liquid, especially hydrophilic or oilphilic.

10. The coalescence filter according to one of the preceding claims, wherein the material of the outlet plate (16) is wettable or non-wettable for the phase to be separated from the immiscible liquid, especially hydrophilic or oilphilic.

11. The coalescence filter according to one of the preceding claims, wherein the chamber (10) has the shape of a cylinder being vertically aligned.

12. The coalescence filter according to one of the preceding claims, wherein the collector particles (30) located within the chamber (10) have a diameter being greater than that of the first and second number of perforations (14, 18).

FIG 1

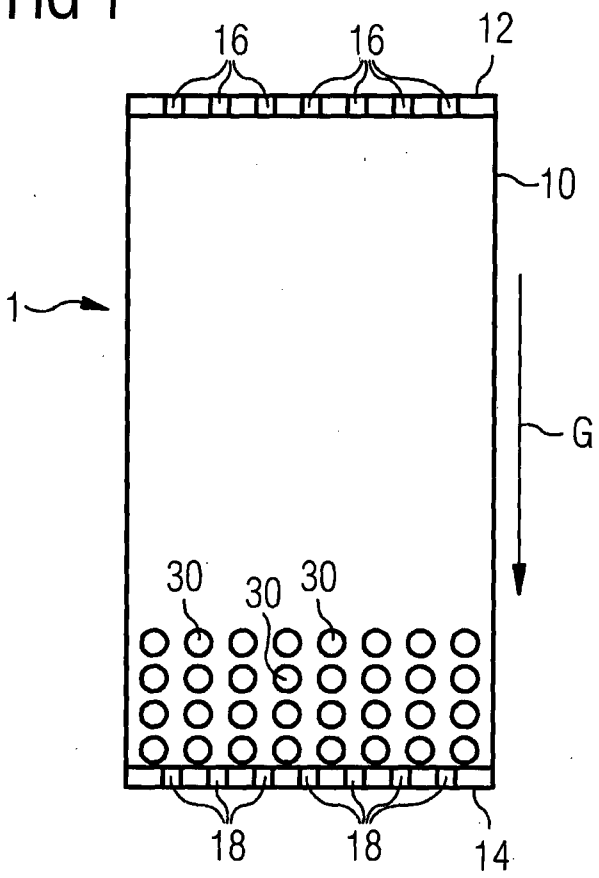


FIG 2

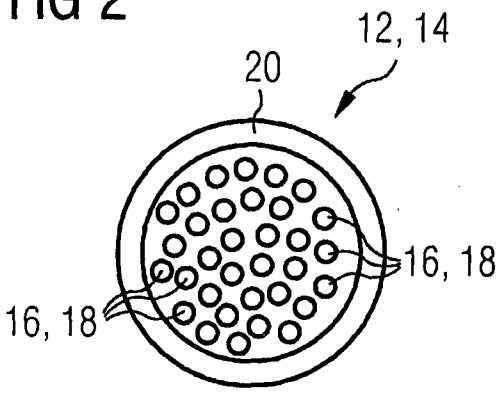


FIG 3

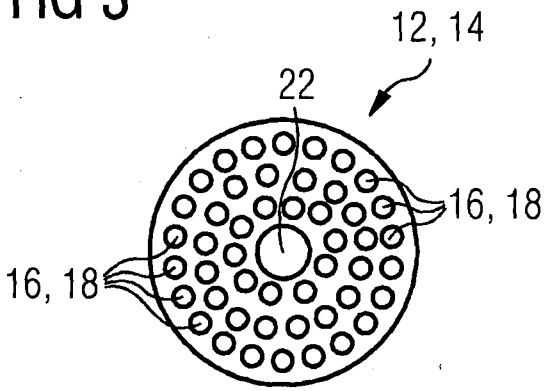


FIG 4

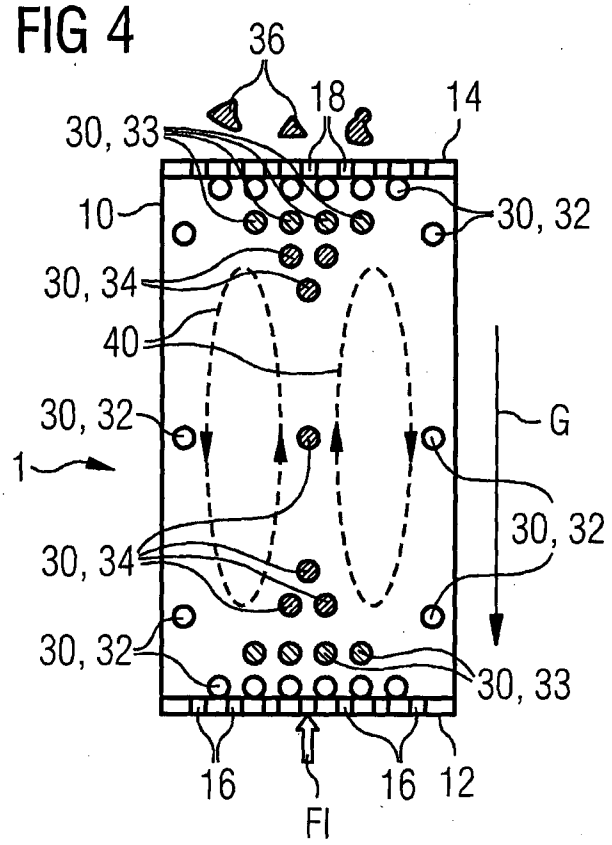
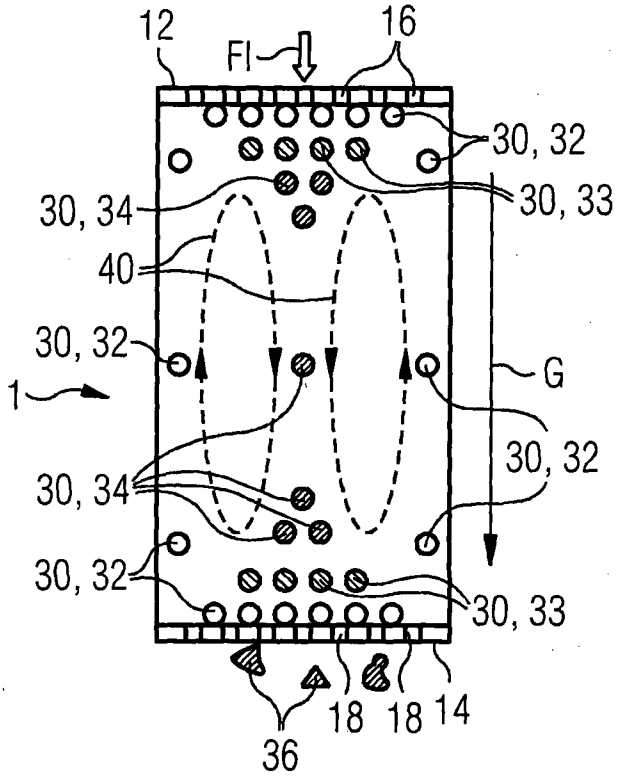

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FIG 5


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INTERNATIONAL SEARCH REPORT

International application No
PCT/RU2011/0O1026

A. CLASSIFICATION OF SUBJECT MATTER
INV. B01D17/02 B01D15/02 B01D17/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B01D C1QG

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/050769 Al (SHENG HENRY P [US]) 18 March 2004 (2004-03-18) paragraph [0003] paragraph [0007] - paragraph [0008] paragraph [0010] - paragraph [0014] claim 16; figure 1	1-12
A	EP 0 148 444 A2 (HOWALDTSWERKE DEUTSCHE WERFT [DE]) 17 July 1985 (1985-07-17) cited in the application claims 1-9; figures 1-3	1-12
A	US 5 462 654 A (HERING J R C J [US]) 31 October 1995 (1995-10-31) claims 1-25; figures la, lb	1-12
A	US 3 016 147 A (COBB CLIFTON A ET AL) 9 January 1962 (1962-01-09) claims 1-5; figures 1,2,5	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 October 2012	19/10/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Garcia Alonso, Nuria

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/RU2011/000026

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004050769 A1	18-03-2004	NONE	
EP 0148444 A2	17-07-1985	DE 3346931 A1	04-07-1985
		EP 0148444 A2	17-07-1985
		JP 60232212 A	18-11-1985
US 5462654 A	31-10-1995	US 5462654 A	31-10-1995
		US 5543037 A	06-08-1996
US 3016147 A	09-01-1962	NONE	