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(54) Title: SYSTEM FOR RECYCLING WASTEWATER RESULTING FROM THE WASHING AND RINSING PROCESS OF A DISHWASHER, ESPECIALLY FOR REUSE IN SAID PROCESS AND FOR IRRIGATION OF PLANTS, AND PROCESS FOR THE USE OF SAID SYSTEM

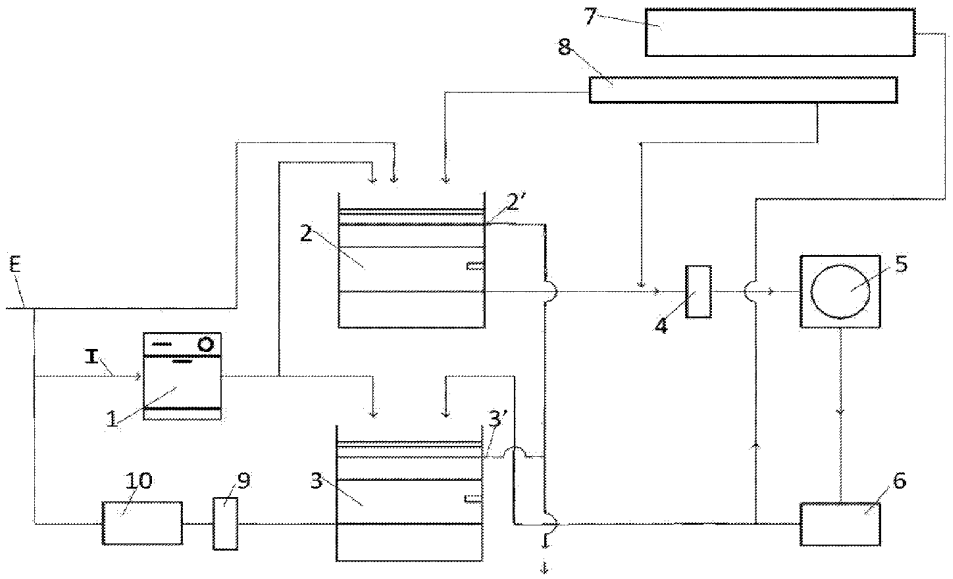

FIG. 1

(57) Abstract: A system for recycling wastewater resulting from the washing and rinsing process of a dishwasher (1) is described, said dishwasher having at least one washing cycle and at least one rinsing cycle, the system comprising: - a plant irrigation system (7) comprising a collection system (8) for collecting drainage irrigation liquid coming from the irrigation system; - a first reservoir (2) adapted to receive and contain liquid drained from the dishwasher as a result of said washing and rinsing cycles and liquid coming from said collection system (8); - a second reservoir (3) adapted to receive and contain a liquid; - a first filter (4) adapted to filter a liquid coming from said first reservoir (2); - a biological filter (5) adapted to further filter the liquid coming from said first filter (4), said biological filter being adapted to transform an organic component of the liquid received from said first filter into an inorganic

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component, comprising nutritious substances for said plants; - a first pumping device (6) adapted to supply the liquid coming out of said biological filter (5) to said plant irrigation system (7) or, if not required by said irrigation system, to said second reservoir (3); - a second filter (9) and a second pumping device (10) respectively adapted to filter and supply liquid contained in said second reservoir (3) to a washing water inlet (I) of said dishwasher (1) as a partial or total replacement for water coming from an external water supply network (E), for supplying water to the dishwasher.

TITLE

"System for recycling wastewater resulting from the washing and rinsing process of a dishwasher, especially for reuse in the same process and for plant irrigation, and method of using said system."

DESCRIPTION

Field of the invention

The present invention relates to a system for recycling wastewater resulting from the washing and rinsing process of a dishwasher, especially for reuse in the same process and for plant irrigation, and to a method of using said system.

Background art

Systems and methods are known in the art for reusing dishwasher wastewater.

Wastewater reuse solutions are known which envisage reverse-osmosis filtering, as described, for example, in WO2005046420, US20100084340 A1, CN206607114U, CN205575789U U. Other solutions envisage partial recycling of the dishwasher wastewater, as described, for example, in KR101315288, WO200563110, CN2712972U, CN205700174U U. Other solutions envisage the use of purification systems, as described, for example, in CN202297260U U and CN102115288 A, which are not specific for dishwasher wastewater.

However, none of such systems allows for complete wastewater reuse, biological filtering and plant irrigation.

The solutions that envisage wastewater purification by reverse osmosis require waste of water and disposal, since each filtering operation produces, in addition to osmotized water, also a concentrate that must then be eliminated.

On the other hand, those solutions which envisage water recycling without purification systems imply the necessity of draining the detergent-containing wastewater part into the sewer system (KR101315288, WO200563110, CN205700174U) or of washing without detergents (CN2712972U).

Summary of the invention

It is therefore the object of the present invention to propose a system for recycling

wastewater resulting from the washing and rinsing process of a dishwasher, especially for reuse in the same process and for plant irrigation, and a method of using said system, which are aimed at overcoming all of the above-mentioned drawbacks.

Within the frame of the present invention, the term "dishwasher" refers to a machine of any size, substantially for domestic or professional use (public places, refectories, etc.), intended for washing, rinsing and possibly drying crockery of any type and dimension.

The technical problems solved by the invention essentially are the following: reuse of the wastewater drained from the dishwasher for the next washing cycle and treatment of the remaining wastewater for plant irrigation purposes. This addresses the necessity of saving water for domestic use and for the cultivation of edible and/or ornamental plants, while at the same time eliminating the wastewater to be disposed of.

The present invention relates to a system for recycling wastewater resulting from the washing and rinsing process of a dishwasher, said dishwasher having at least one washing cycle and at least one rinsing cycle, the system comprising:

- a plant irrigation system comprising a collection system for collecting drainage irrigation liquid coming from the irrigation system;
- a first reservoir adapted to receive and contain liquid drained from the dishwasher as a result of said washing and rinsing cycles and liquid coming from said collection system;
- a second reservoir adapted to receive and contain a liquid;
- a first filter adapted to filter a liquid coming from said first reservoir;
- a biological filter adapted to further filter the liquid coming from said first filter, said biological filter being adapted to transform an organic component of the liquid received from said first filter into an inorganic component, comprising nutritious substances for said plants;
- a first pumping device adapted to supply the liquid coming out of said biological filter to said plant irrigation system or, if not required by said irrigation system, to said second reservoir;
- a second filter and a second pumping device respectively adapted to filter and supply liquid contained in said second reservoir to a washing water inlet of said dishwasher as a partial or total replacement for water coming from an external water supply network, for supplying water to the dishwasher.

It is a particular object of the present invention a system for recycling wastewater resulting from the washing and rinsing process of a dishwasher, especially for reuse in the same process and for plant irrigation, and a method of using said system, as will be further set out in the claims, which are an integral part of the present description.

Brief description of the drawings

Further objects and advantages of the present invention will become apparent from the following detailed description of a preferred embodiment (and variants) thereof and from the annexed drawings, which are supplied merely by way of non-limiting example, wherein:

Figure 1 shows a simplified exemplary hydraulic diagram of the system according to the present invention;

Figure 2.1 shows an exemplary operation of the biological filter of the system;

Figure 2.2 shows an exemplary embodiment of the biological filter of the system;

Figure 3 highlights a complete exemplary hydraulic diagram of the system of Figure 1;

Figure 4 shows an exemplary operational flow chart of the control of the system.

In the drawings, the same reference numerals and letters identify the same items or components.

Detailed description of some embodiments of the invention

The following will describe a first variant embodiment of the invention.

With reference to Figure 1, which shows a simplified exemplary hydraulic diagram of the system, numeral 1 designates a dishwasher, having at least one washing cycle, a first rinsing cycle, and a second rinsing cycle following the first rinsing cycle. The dishwasher may have additional cycles, e.g. drying cycles. The dishwasher is normally equipped with a washing water inlet I.

Numeral 2 designates a first reservoir for containing the wastewater drained from the dishwasher as a result of the washing cycle and the first rinsing cycle. The liquid contained in the first reservoir 2 may normally contain substances resulting from the washing and rinsing processes.

Numeral 3 designates a second reservoir for containing the wastewater drained from

the dishwasher as a result of the second rinsing cycle. The liquid contained in the second reservoir may normally contain fewer residual substances, smaller in size, than the liquid in the first reservoir.

The reservoirs 2 and 3 are preferably fitted with an overflow channel (respectively designated as 2' and 3'), capable of draining any excess liquid, e.g. into the sewer system, so as to prevent overflow.

The liquid in the first reservoir 2 is supplied to a first filter 4 of a type capable of trapping any particles which are bigger than 80 micron, e.g. of the wound-wire type, which is per se known, and therefore capable of eliminating larger residues.

The output of the first filter 4 is supplied to a biological filter 5, which will be described in detail below, which can generate a liquid suitable for plant irrigation.

The liquid exiting the biological filter 5 is then supplied to a plant irrigation system 7 by means of a pumping device 6.

In one implementation example, the pump 6 is an immersion or pressure or peristaltic pump, capable of maintaining a liquid pressure of 1.5 to 3 bar in the irrigation system 7.

A collection-channel system 8 may be present for collecting the drainage of excess irrigation liquid coming from the irrigation system 7. From the collection channel 8, the liquid is fed again into the first reservoir 2 for reuse in the irrigation system. It is also possible to deliver the liquid from the collection channel 8 back to the inlet of the first filter 4.

The liquid exiting the pump 6 can also be fed back into the second reservoir 3, e.g. in time periods when irrigation is not necessary.

It is one goal of the present invention to minimize or even eliminate the need for supplying water into the dishwasher from the outside, and to recirculate the liquid in the system as much as possible. Therefore, the liquid in the second reservoir 3 is delivered to a filter 9 and, by means of a suitable pumping device 10, to the washing water inlet I of the dishwasher 2 in order to replace, as much as possible, the water that would normally have be taken in from the external water supply network E.

The filter 9 is, for example, of the type capable of trapping particles bigger than 5 micron, e.g. made of polyethylene microfibres, which is per se known. It can therefore make the characteristics of the liquid in the reservoir 3 similar to those of the water in the

external water supply network E.

The pump 10 is, for example, an immersion, pressure or peristaltic pump capable of reaching the pressure found in the external water supply network E.

Water can be supplied into the first reservoir 2 from the external water supply network E when the level of the liquid therein drops below a pre-set minimum.

An example of the operation of the biological filter 5 will now be described with reference to Figure 2.1, which shows a schematic structure thereof.

When entering the biological filter, the dishwater wastewater has high contents of salts, organic residues, phosphates, nitrates and potassium.

The biological filter internally contains a quantity of water filling its entire volume. In the biological filter there are fixed or mobile structures acting as a substrate 21 for the formation/development/adhesion of complex microbial communities: the latter include cyanobacteria and other bacteria that are already naturally present in dishwasher wastewater, which establish functional and spatial associations to compose a biofilm, i.e. a three-dimensional reticular biological structure. Such biofilm is composed of photosynthetic organisms and heterotrophic bacteria.

The biofilm performs a dual function: due to its own structure, it acts as a mechanical filter 22 trapping the larger particulate contained in the wastewater, if it has not already been trapped by the filter 4. At the same time, by exploiting the metabolic activities of the association between cyanobacteria and heterotrophic bacteria, the biofilm effects a considerable reduction 23 of the organic component, transforming it into inorganic component, i.e. nutrients useful for plants to be irrigated. In order to stimulate the filtering activity, there is an illumination system 24, which can be adjusted according to the biological necessities of the biofilm.

The output filtrate includes nutrients useful for plants, thus permitting efficient reuse of wastewater for plant cultivation purposes.

The following will describe an exemplary and non-limiting embodiment of the biological filter 5 with reference to Figure 2.2, which highlights one possible structure thereof, in the case of the above-mentioned fixed substrate structures.

The filter may consist of a transparent hollow-spiral coil 30 with a corrugated inner surface, made of plastic material, adapted to provide a suitable environment for

photosynthetic organisms and heterotrophic bacteria, which adhere to the corrugated inner surface in the form of a biofilm.

The liquid coming from the filter 4, and therefore from the reservoir 2 collecting the dishwasher drain and/or from the channel 8 collecting the drainage of excess irrigation liquid of the irrigation system 7, enters the coil 30 through an inlet 31. The filtered liquid flows out of the coil on the opposite side 32 towards the pump 6 of the irrigation system.

For filter cooling purposes, the coil 30 is wound around a hollow tube 33, e.g. made of plastic material, through which the liquid of the channel for collecting the drainage of excess irrigation liquid and/or mains water can pass before entering the dishwasher. In fact, the liquid that flows into the filter, coming from the dishwasher, may have too high a temperature, thus potentially damaging the microbial communities in the filter. An example of a correct temperature in the filter is room temperature; therefore, a device for monitoring the filter temperature may be present, which activates the intake of cooling water as necessary.

Due to its extensive contact surface, the coil may however contribute to lowering the temperature of the drain water coming from the dishwasher to acceptable levels for the microbial communities in the filter.

The filter is enclosed in a suitable container 34, shown split into two semicircular cavities in Figure 2.2, also made of transparent plastic material.

The illumination necessary for allowing the filtering activity inside the filter comes from the transparency of the filter material, which receives light from the outside. The light may be environmental light or artificial light, e.g. light that may already be present for illuminating the plants to be irrigated, which is necessary for the plants' vital process.

Figure 3 shows a complete hydraulic diagram of the system of Figure 1. The elements designated by the same numerals have already been described above.

The flows of liquid in the various ducts are regulated by electrovalves EV1, ... EV10, EVS, EVI1, EVI2, the opening and closing of which is appropriately controlled as will be described below.

On the water inlet duct E, the irrigation inlet duct and the pump 10 outlet duct, meters CN1, CN2, CN3, e.g. Hall-effect meters, may be fitted for evaluating the consumption of drinking water, the quantity of water used for irrigation, and the quantity of water recycled for the washing process.

The irrigation system 7 may be, for example, of the drip-wing type, i.e. self-compensating irrigation lines for uniform distribution of irrigation water over plants arranged, for example, in horizontal and/or vertical rows along the irrigation lines; however, any other type of system may be employed as well.

A non-return valve VNR and a low pressure switch PRS, capable of closing at low pressure, may be installed on the outlet duct of the pump 10 for adjusting the pump outflow.

Moreover, the reservoirs 2 and 3 may be equipped with level sensors. The reservoir 2 may be equipped with a temperature sensor, e.g. to avoid delivering excessively hot liquid to the irrigation system and causing damage to the plants.

The irrigation system may comprise an artificial plant illumination system, e.g. for plants located in a confined environment with poor or no natural lighting.

The operation and functionality of the above-described components is controlled by a control and check system 38 (Figure 3), which comprises, by way of non-limiting example, a suitably programmed electronic microcontroller. This may also be connected, via the Internet network, to a remote controller by means of a user interface in the form of a smartphone app, and/or to a local, remote or cloud database.

One non-limiting example of an operational control flow, handled by the electronic microcontroller, will now be described with reference to the flow chart of Figure 4. The operational flow essentially involves controlling the liquid flows between the dishwasher and the reservoirs, as well as the irrigation system. The two control flows are interrelated.

Control is achieved over the liquid flows between the dishwasher and the reservoirs by means of the control and check system 38 in accordance with the following operational flow.

At the beginning (START, block 40), corresponding to the start of a washing cycle of the dishwasher, it controls if the reuse reservoir 3 contains any liquid (block 41). If yes, it opens the electrovalve EV10 between the reservoir 3 and the filter 9, and activates the pump 10. Otherwise it goes to block 44.

Then it checks (block 43) if the quantity of liquid in the reservoir 3 is sufficient for the washing phase of the dishwasher 1. If yes, it goes to block 45. Otherwise it goes to block 44, wherein it closes the electrovalve EV10, turns off the pump 10, and opens the electrovalve EV1 between the water supply network inlet E and the dishwasher 1.

At block 45, it checks if the accumulation reservoir 2 is full. If it is not, it opens the electrovalve EV2 for delivering into the reservoir 2 the liquid coming from the washing and first rinsing phases of the dishwasher 1 (block 46), and then goes to block 54. Otherwise it goes to block 47, wherein it closes the electrovalve EV2.

Then it checks (block 48) if the reuse reservoir 3 is full. If yes, it goes to block 49, otherwise it goes to block 52, wherein it opens the electrovalve EV3 for delivering the liquid of the second rinsing phase into the reservoir 3. Then it goes to block 53.

At block 49, it closes the electrovalve EV3 and the electrovalve EV8 for delivering into the reservoir 3 the liquid coming from the pump 6. Then it goes to block 50, wherein it checks if both reservoirs 2 and 3 are full and the irrigation system is off. If yes, it opens the overflow electrovalve EVS of the reservoirs, then goes to block 52. Otherwise it goes directly to block 52 and then to block 53.

At block 53 it checks if the dishwasher cycle has ended. If yes, it closes the electrovalves EV1, EV2, EV3, EV10, turns off the pumps 6 and 10, and then ends (END, block 55). Otherwise it goes back to block 43.

Control over the irrigation system is achieved in accordance with the following operational flow.

At the beginning (START, block 60), corresponding to a possible start of an irrigation cycle, it checks (block 61) if irrigation has been programmed or irrigation is actually necessary on the basis of detections made by suitable soil humidity sensors. If yes, it goes to the next block 62. Otherwise it ends (END, block 72).

At block 62, corresponding to the actual start of the irrigation, it checks if the level of the liquid in the accumulation reservoir 2 is sufficient. If it is not, it opens the electrovalve EV7 for delivering water into the reservoir 2 from the water supply network E. Otherwise it goes to block 64, wherein it activates the pump 6, opens the valve EV4 for delivering the liquid in the reservoir 2 to the filter 4, and opens the valve EV5 for delivering irrigation liquid from the pump 6 to the irrigation system 7.

Then it goes to block 65, wherein it opens the electrovalves EVI1, EVI2 for opening the irrigation system. It then opens the electrovalve EV6 (block 66) for delivering the liquid collected by the channel 8 into the reservoir 2.

Then it checks (block 67) if the accumulation reservoir 2 is full. If yes, it closes the electrovalve EV6 and opens the electrovalve EV9 for delivering liquid from the collection

channel 8 to the filter 4, and then goes to block 69. Otherwise it goes directly to block 69.

At block 69 it checks if the irrigation cycle has ended (block 69). If it has not ended, it goes back to block 62. If it has ended, it closes the electrovalves EV4, EV5, EVI1, EVI2 and opens the electrovalve EV8. Then, at block 71, it closes the electrovalves EV6, EV9, EV8. Then it ends (END, block 72).

The operational control flow of the present invention can advantageously be implemented by means of a computer program, wherein said electronic microcontroller, which comprises coding means for implementing one or more steps of the method, when said program is executed by a computer. It is understood, therefore, that the protection scope extends to said computer program and also to computer-readable means that comprise a recorded message, said computer-readable means comprising program coding means for implementing one or more steps of the method, when said program is executed by a computer.

The above-described non-limiting example of embodiment may be subject to variations without however departing from the protection scope of the present invention, including all equivalent implementations known to a person skilled in the art.

In further exemplary variant embodiments, the dishwasher may comprise one or more washing and rinsing cycles ending with a single phase for draining the wastewater produced at the end of each cycle, or one wastewater draining phase at the end of the washing cycle and another wastewater draining phase at the end of the rinsing cycles.

In such cases, the wastewater drained from the dishwasher will only be delivered to the first reservoir 2 (Fig. 1), and not to the second reservoir 3. The latter will then receive, through the pump 6, the liquid coming from the biological filter 5, as previously described.

The above-described system, as well as anything else previously described in relation to the operation of the system, remains unchanged.

What is modified is the control of the phases of opening and closing the valves EV2, EV3 (Fig. 3). De facto, the valve EV3 will always remain closed or may even be absent, resulting in the absence of the drain duct between the liquid outlet of the dishwasher and the reservoir 3. The valve EV2 will be opened either at the end of the washing cycles, if the liquid is drained at the end of said cycles, or only at the end of all the washing and rinsing cycles.

Further system operation variations are also possible, which will depend on the

operational sequence of the various washing and rinsing cycles to be executed, and hence on the time intervals in which wastewater is drained from the dishwasher. The valves EV2 and EV3 will be opened and closed as a function of said washing and rinsing cycles and said time intervals.

The elements and features shown in the various preferred embodiments may be combined together without however departing from the protection scope of the present invention.

From the above description, those skilled in the art will be able to produce the object of the invention without the need for any further descriptive details.

CLAIMS

1. System for recycling wastewater resulting from the washing and rinsing process of a dishwasher (1), said dishwasher having at least one washing cycle and at least one rinsing cycle, the system comprising:

- a plant irrigation system (7) comprising a collection system (8) for collecting drainage irrigation liquid coming from the irrigation system;

- a first reservoir (2) adapted to receive and contain liquid drained from the dishwasher as a result of said washing and rinsing cycles and liquid coming from said collection system (8);

- a second reservoir (3) adapted to receive and contain a liquid;

- a first filter (4) adapted to filter a liquid coming from said first reservoir (2);

- a biological filter (5) adapted to further filter the liquid coming from said first filter (4), said biological filter being adapted to transform an organic component of the liquid received from said first filter into an inorganic component, comprising nutritious substances for said plants;

- a first pumping device (6) adapted to supply the liquid coming out of said biological filter (5) to said plant irrigation system (7) or, if not required by said irrigation system, to said second reservoir (3);

- a second filter (9) and a second pumping device (10) respectively adapted to filter and supply liquid contained in said second reservoir (3) to a washing water inlet (I) of said dishwasher (1) as a partial or total replacement for water coming from an external water supply network (E), for supplying water to the dishwasher.

2. System for recycling wastewater according to claim 1, wherein said second reservoir (3) is also adapted to contain liquid drained from the dishwasher as a result of said at least one rinsing cycle.

3. System for recycling wastewater according to claim 1, wherein said biological filter (5) comprises:

- a transparent hollow-spiral coil (30) with a corrugated inner surface, made of plastic material, through which said liquid coming from said first filter (4) flows in and out towards said first pumping device (6), said coil being configured to produce said transformation of the organic component of the liquid into an inorganic component;

- an adjustable illumination system (24) facing towards said coil, adapted to stimulate

said transformation.

4. System for recycling wastewater according to claim 3, wherein said biological filter (5) further comprises:

- a hollow tube (33) around which said coil (30) is wound, and configured for letting in intake liquid (I) to be supplied into said dishwasher and/or drainage liquid coming from said plant irrigation system (7), for the purpose of cooling the biological filter;

- a container (34) for said biological filter, made of transparent plastic material.

5. System for recycling wastewater according to any one of the preceding claims, wherein said first and second reservoirs (2, 3) are fitted with an overflow channel (2', 3') adapted to drain any excess liquid, so as to prevent overflow.

6. System for recycling wastewater according to any one of the preceding claims, wherein said first filter (4) is of the type capable of trapping particles that are bigger than 80 microns, preferably of the wound-wire type.

7. System for recycling wastewater according to any one of the preceding claims, wherein said first pumping device (6) comprises an immersion or pressure or peristaltic pump, capable of maintaining a liquid pressure of 1.5 to 3 bars in the irrigation system (7).

8. System for recycling wastewater according to any one of the preceding claims, comprising electrovalves (EV1 – EV10, EVI1, EVI2, EVS) adapted to control the intake and delivery of liquid to and from said first reservoir (2) and second reservoir (3), and said irrigation system (7, 8).

9. Method for controlling a system for recycling wastewater resulting from the washing and rinsing process of a dishwasher (1) according to claim 1, the method comprising:

- controlling said plant irrigation system (7) and said collection system (8) for collecting drainage irrigation liquid coming from the irrigation system;

- controlling said first reservoir (2) for receiving and containing liquid drained from the dishwasher as a result of said washing and rinsing cycles, and liquid coming from said collection system (8);

- controlling said first filter (4) for filtering a liquid coming from said first reservoir (2);

- controlling said biological filter (5) for further filtering the liquid coming from said first filter (4);

- controlling said first pumping device (6) for supplying the liquid coming out of said biological filter (5) to said plant irrigation system (7) or, if not required by said irrigation system, to said second reservoir (3);

- controlling said second filter (9) and said second pumping device (10) for respectively filtering and supplying liquid contained in said second reservoir (3) to a washing water inlet (I) of said dishwasher (1) as a partial or total replacement for water coming from an external water supply network (E), for supplying water to the dishwasher.

10. Method for controlling a system for recycling wastewater according to claim 9, comprising controlling said second reservoir (3) for receiving and containing drain liquid coming from the dishwasher as a result of said at least one rinsing cycle.

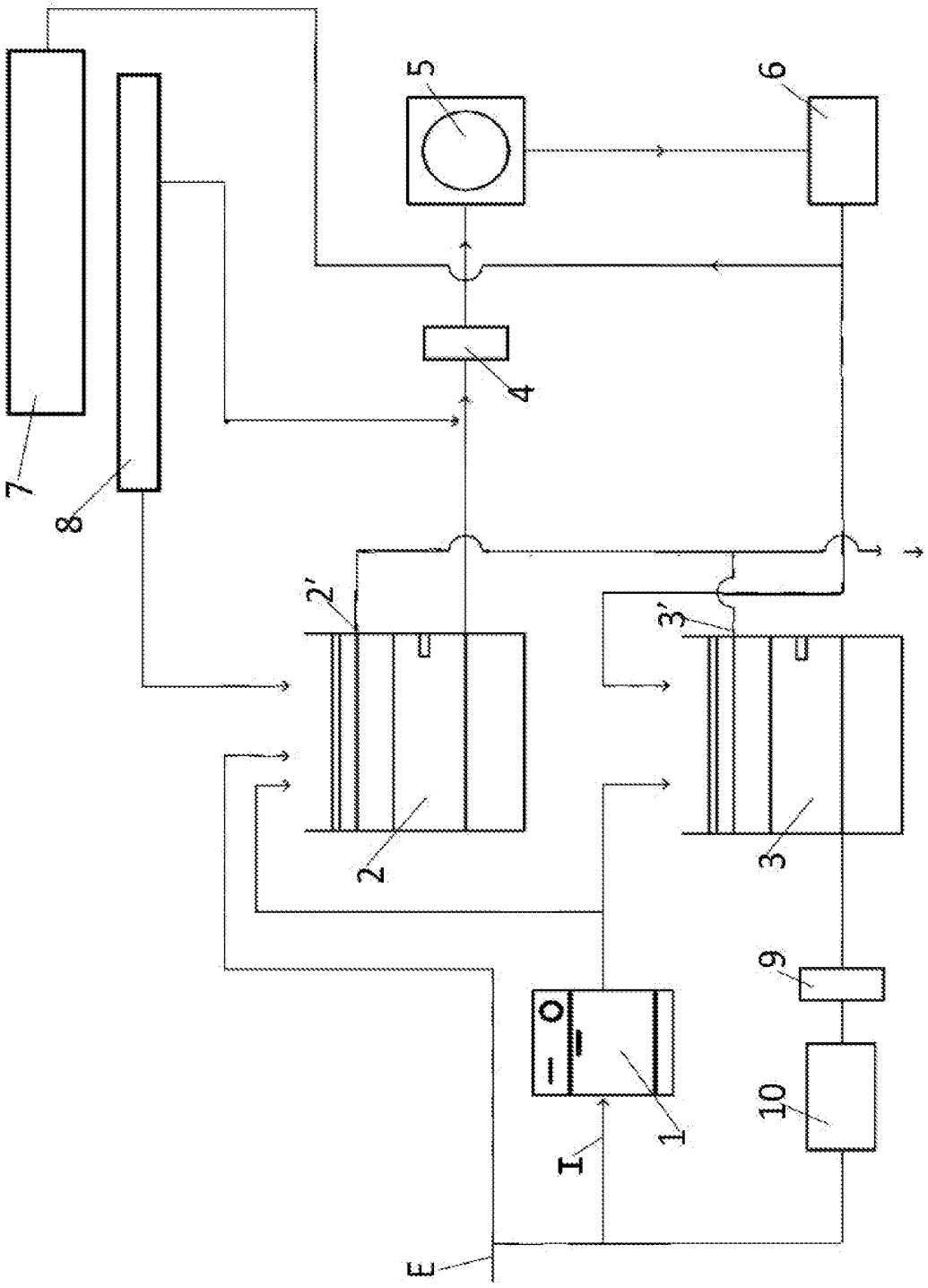


FIG. 1

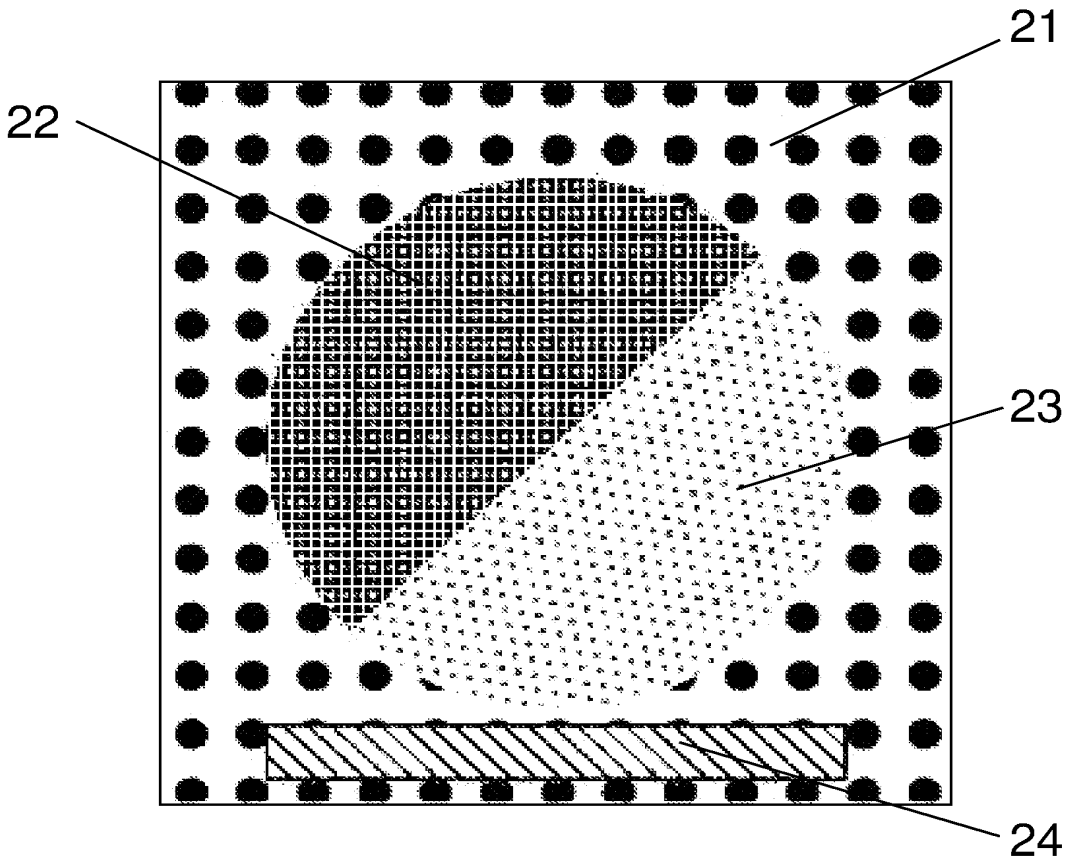


FIG. 2.1

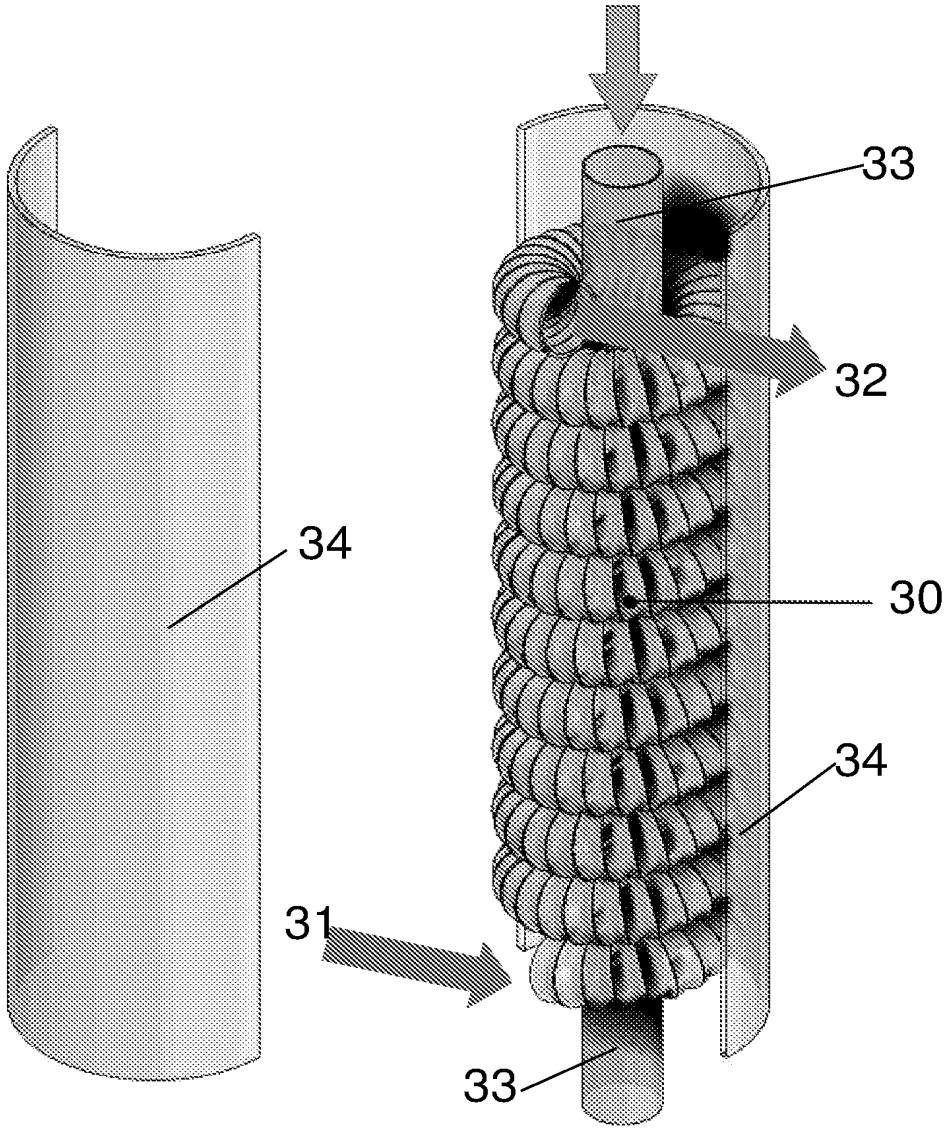
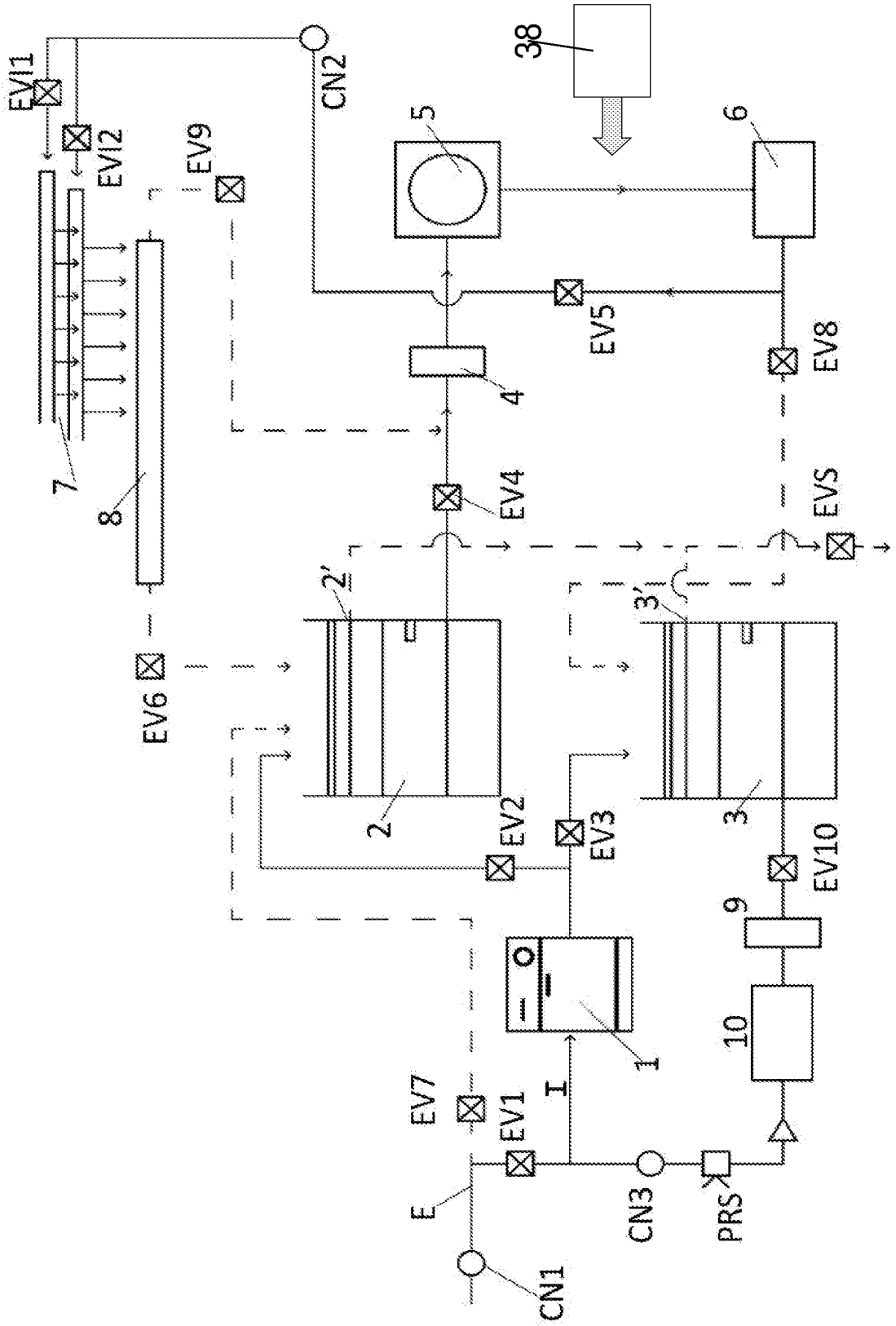


FIG. 2.2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EV5
EV8
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8
EV4
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EV6
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CN3
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CN1

FIG. 3

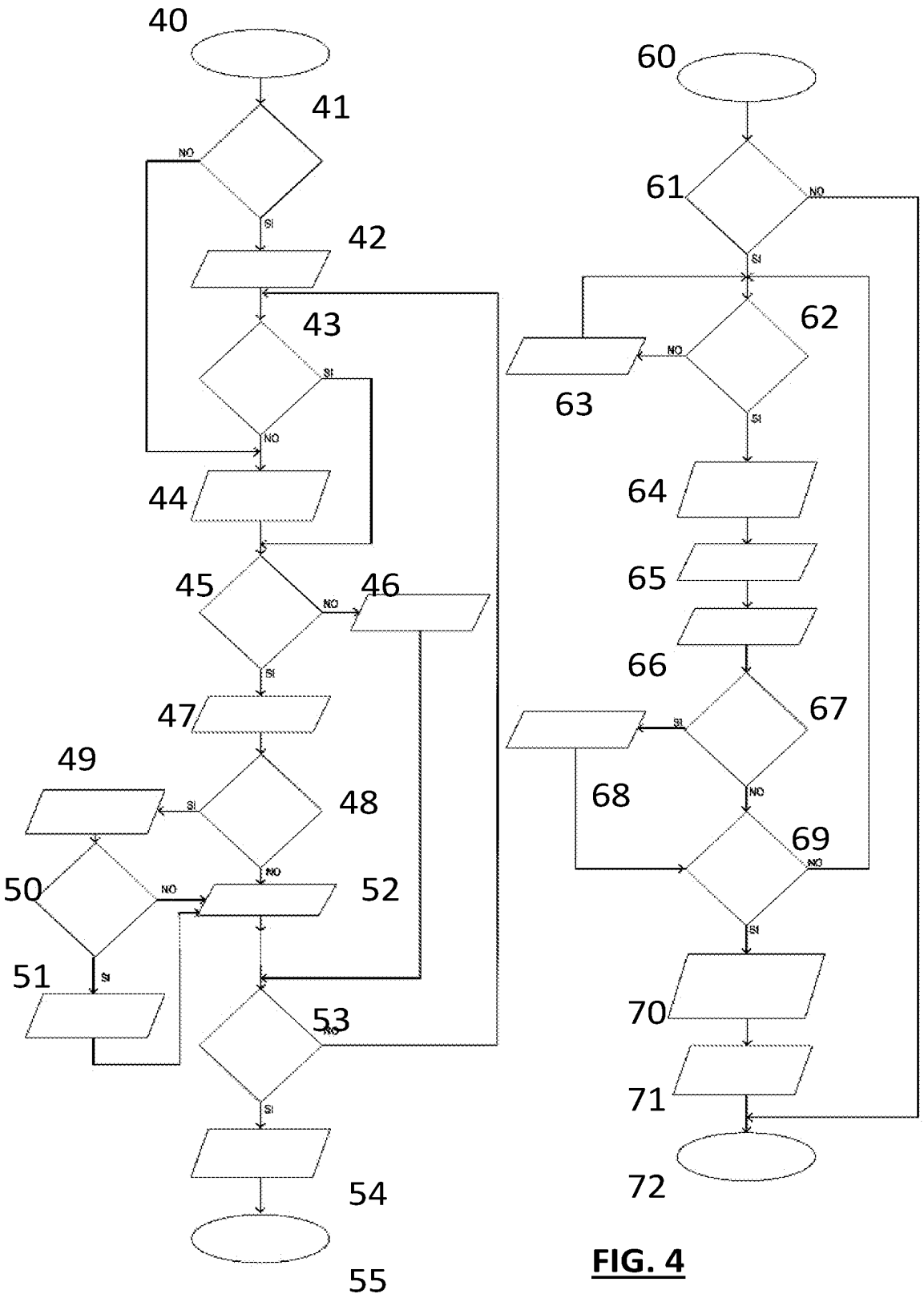
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FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2020/052847

A. CLASSIFICATION OF SUBJECT MATTER
INV. C02F3/34 C02F3/06 C02F3/10 C02F1/00 A01G25/00
A47L15/42 E03B1/04
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)
C02F A47L A01G E03B

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.
A	US 5 173 180 A (STEWART GARY [US] ET AL) 22 December 1992 (1992-12-22) figure 1 column 1, lines 5-12, 35-53 column 2, line 5 - column 3, line 51 -----	1-10
A	US 2007/022789 A1 (HEILIGENMANN CAROLINE [DE] ET AL) 1 February 2007 (2007-02-01) figures 1-2 paragraphs [0003] - [0038] ----- -/--	1-10

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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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
14 July 2020	23/07/2020

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	Rozanska, Agnieszka

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2020/052847

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2012/065250 A1 (UNIV REGINA [CA]; YOUNG STEPHANIE [CA]; MUNOZ ALEX [CA]) 24 May 2012 (2012-05-24) figure 1 page 2, paragraph 3-4 page 3, paragraph 2 - page 4, paragraph 2 page 5, paragraph 3-4 page 8, paragraph 5 - page 9, paragraph 1	1-10
A	WO 2014/166624 A1 (CLEI S R L [IT]) 16 October 2014 (2014-10-16) page 5, line 21 - page 8, line 23	1-10
A	EP 2 786 970 A1 (BARTOSZ SP J BUJWICKI SOBIECH F [PL]) 8 October 2014 (2014-10-08) the whole document	1-10
A	JP 2013 039515 A (TECHNO KANKYO KIKI KK; RABOTEKKU KK) 28 February 2013 (2013-02-28) the whole document	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2020/052847

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5173180 A	22-12-1992	NONE	
US 2007022789 A1	01-02-2007	AT 392849 T	15-05-2008
		CN 1886085 A	27-12-2006
		DE 10355139 A1	30-06-2005
		EP 1689279 A1	16-08-2006
		ES 2305907 T3	01-11-2008
		PL 1689279 T3	30-09-2008
		US 2007022789 A1	01-02-2007
		WO 2005051157 A1	09-06-2005
WO 2012065250 A1	24-05-2012	NONE	
WO 2014166624 A1	16-10-2014	NONE	
EP 2786970 A1	08-10-2014	EP 2786970 A1	08-10-2014
		RU 2014112750 A	10-10-2015
JP 2013039515 A	28-02-2013	NONE	