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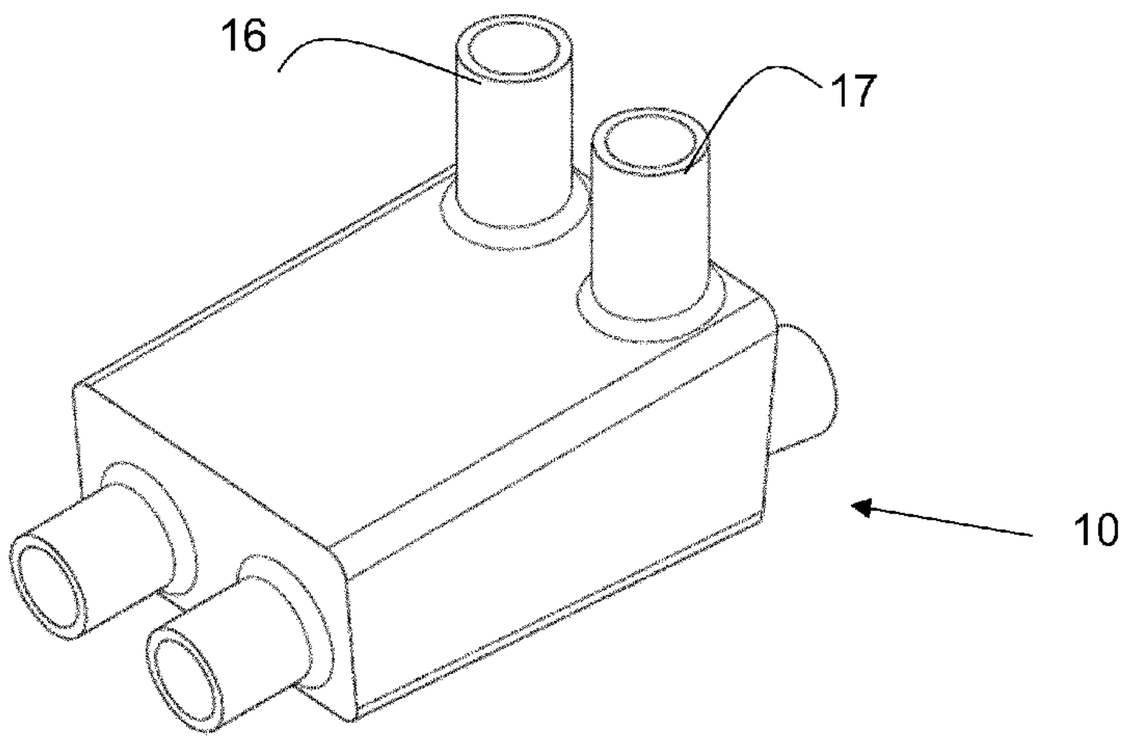


Fig. 5

(57) Abstract: The invention relates to an air-conditioner and in particular to a fluid tank (10) configured to connect an indoor unit of an air-conditioner with an outdoor unit (102) of the air-conditioner. The fluid tank comprises a first chamber (60), and a second chamber (50). The first chamber comprises a high-pressure inlet (11) and a high-pressure outlet (14). the second chamber comprising a low-pressure inlet (13), a low-pressure outlet (12) and a low- pressure filling opening (16).

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AIR-CONDITIONER WITH FLUID TANK

TECHNICAL FIELD

The invention relates to an air conditioner. In particular the present invention relates to a fluid tank connectable between an indoor unit and an outdoor unit of an air-conditioner.

BACKGROUND

Air conditioning is a collective expression for conditioning air into a desired state. It could be heating the air during cold periods, cooling the air during warmer periods or for cleaning the air if it contains unwanted particles. However, the expression air conditioning is most often used when emphasizing cooling. As a product, air conditioners can look and be used in various ways, but they all share the same basic technology. The air-conditioner comprises a compressor, a condenser, an evaporator, and typically also an expansion device.

There are different types of air-conditioners. One type of air-conditioner can be referred to as a split air-conditioner. In a split air conditioner, the condenser and the evaporator are located in two different separated units that are interconnected via pipes to circulate a refrigerant from one unit to the other.

Another type of air-conditioner can be referred to as Packaged Air Conditioner. A Packaged Air Conditioner (AC) can be said to be a type of self-contained system, in which all the cooling cycle components, such as the compressor, condenser, expansion device, evaporator and control system are enclosed in a single package. Among the packaged systems, the most commonly used for residential applications are the Window-type ACs, Packaged Terminal AC's (PTAC), and also Portable AC units.

The Packaged Air Conditioner has the advantages of easy installation, relatively small footprint, flexibility for heating/cooling individual rooms and low cost.

In contrast, Split Air Conditioners comprise at least two factory-made separated assemblies, designed to be used together. In a split system, the outdoor unit is separated by some distance from the indoor one(s) by means of semi rigid pipes which contain the refrigerant (at high pressure) that produces the cooling/heating effect in the system. Among other advantages, split systems can provide high efficiency ratios in a wide range of capacities and working conditions. Additionally, in split AC systems, the compressor, outdoor heat exchanger and outdoor fan can be located further away from the inside space, rather than merely on the other side of the same unit (as in PTACs or window air conditioners), achieving lower indoor noise levels.

When installing an air-conditioner having an outdoor unit, such as a split air conditioner or a similar type of air conditioner, installation is often difficult and requires licensed personnel. This is, at least in part because the refrigerant used in most air-conditioners is hazardous. However, some systems allow for the use of non-hazardous fluids in the air-conditioner. In such air-conditioners any person can be allowed to perform installation and maintenance. Thus, the term non-hazardous is used herein to define a fluid legal to be handled by an un-licensed person. PCT/EP/2017082610 describes an exemplary air-conditioner capable of using a non-hazardous fluid to exchange/ transfer heat between an indoor unit and an outdoor unit of an air-conditioner.

There is a constant desire to improve air conditioners. Hence, there exists a need for an improved air conditioner and in particular an improved mechanism for installation and maintenance of air-conditioners.

SUMMARY

It is an object of the present invention to provide an improved air-conditioner and in particular an improved device for use in an air-conditioner.

This object is obtained by a device as set out in the appended claims.

In accordance with the invention a fluid tank configured to connect an indoor unit of an air-conditioner with an outdoor unit of the air-conditioner is provided. The fluid tank comprises a first chamber and a second chamber. The first chamber comprises a high-pressure inlet and a high-pressure outlet. The second chamber comprises a low-pressure inlet, a low-pressure outlet and a low-pressure filling opening. Hereby a connection device can be obtained that facilitates installation of an air-conditioner. The connection device formed by the fluid tank allows for easy filling of heat transfer fluid in the air-conditioner and easy removal of air from the circulating heat transfer fluid system of the air-conditioner.

In accordance with one embodiment, the first chamber comprises a high-pressure filling opening. Hereby filling of heat transfer fluid can be performed also on the high-pressure side of the heat transferring fluid system.

In accordance with one embodiment, a top section of the fluid tank is inclined and the high-pressure filling opening and or low-pressure filling opening are located at a top portion of the inclined top section. Hereby air in the circulating heat transfer fluid system of the air-conditioner can be caught in the top section and because the filling opening(s) are located at the top air can easily be removed from the circulating heat transfer fluid system of the air-conditioner.

In accordance with one embodiment, the high-pressure inlet, the high-pressure outlet the low-pressure inlet, and the low-pressure outlet are located on side walls of the fluid tank. Hereby, the fluid tank can be easy to fit to connectors of the circulating fluid system of the air-conditioner.

In accordance with one embodiment, at least one of the high-pressure inlet, the high-pressure outlet the low-pressure inlet, and the low-pressure outlet is inclined in relation to a bottom portion of the fluid tank. For example, the inlets/outlets can point slightly in a direction downwards (towards the bottom portion). Hereby the fitting to connectors of the circulating fluid system of the air-conditioner can be further facilitated. The high-pressure inlet, the high-pressure outlet the low-pressure inlet, and the low-pressure outlet can in some embodiments be provided with quick connectors to further facilitate installation of the fluid tank.

In accordance with one embodiment, at least one of the first chamber and the second chamber is provided with a purge valve. The purge valve be provided on a cap of a filling opening. The purge valve can in one embodiment be provided on the first, high pressure, chamber. Hereby air-removal from the circulating fluid system of the air-conditioner can be made easier.

The invention also extends to an air conditioner comprising an indoor unit and an outdoor unit, where a non-hazardous fluid is circulated between the indoor unit and the outdoor unit in a circulation system, and where the air conditioner comprises a fluid tank according to the above in the fluid path of the non-hazardous fluid circulated between the indoor unit and the outdoor unit. The fluid tank can be configured to be installed at a highest position of the fluid path of the non-hazardous fluid circulated between the indoor unit and the outdoor unit.

The fluid circulated between the indoor unit and the outdoor unit can be a water-based fluid or an alcohol or some other fluid legally handled be any person such that no special license or permit is required to install the air-conditioner.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example, and with reference to the accompanying drawings, in which:

Fig. 1 shows a general view of an air-conditioner installation through a window opening,

Fig. 2 is a view in perspective of an air-conditioner installed in a window opening,

Figs. 3 and 4 show a fluid tank of an air-conditioner installation,

Fig. 5 is a view in perspective of a fluid tank,

Fig. 6 is a side view of a fluid tank,

Fig. 7 is a cross-sectional view of a fluid tank, and

Fig. 8 is a cross-sectional view from the side of a chamber partly filled with fluid with a cap removed from the filling opening.

DETAILED DESCRIPTION

The invention will now be described more fully hereinafter with reference to the accompanying drawings, in which certain embodiments of the invention are shown. The invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of example so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. For example, like or similar components of different embodiments can be exchanged between different embodiments. For example, an air conditioner can be described herein as a cooling system, but the cooler can equally be a heater if the system is run in a heating mode. Some components can be omitted from different embodiments. Like numbers refer to like elements throughout the description.

As has been realized by the inventor, air-conditioners of a split type are difficult and often expensive to install. Also, maintenance can be difficult to perform.

Below a description of an air-conditioner of a split type is given. The description with reference to Fig. 1 is given for providing a context to better understand the benefits of the invention. Fig. 1 illustrate a Monoblock Air Conditioners (mini-chiller) / Monoblock heat pump that transfer energy between Indoor and Outdoor via a fluid, typically water. In some installations a short water loop is connected to a fan coil that cools air using cold water directly from an outdoor heat pump unit of an air-conditioner 100.

Fig. 1 shows a schematic diagram of an embodiment of an air-conditioner 100. The air-conditioner 100 can be said to be of a split type comprising an indoor unit 101 and an outdoor unit 102. The units 101, 102 are interconnected via an intermediate circulation system 103 for circulating a fluid, between the indoor unit 101 and the outdoor unit 102. Also depicted is a window 105 where the air-conditioner 100 is installed.

The circulating system 103 used to transfer heat between the indoor unit 101 system can be a low-pressure system it can use an energy transport media that is easy to handle, such as water a water-based solution, or some other liquid media such as ethanol. In particular any non-hazardous liquid can be used in the circulation system 103.

In Fig. 2 the air-conditioner 100 is depicted in a perspective view from the outside of the window. In Fig. 2 an area C is marked.

Fig. 3 is a view of the area C of Fig. 2 from the outside. Fig. 3 depicts a part of the circulation system 103 with a fluid tank 10 located in the circulating system 103. It is to be noted that the view of Fig. 3 is shown with the circulation system disconnected from the fluid tank 10. The fluid tank 10 has an inlet 11 and an outlet 12 that can be connected to the circulation system.

Fig. 4 is a view similar to the view in Fig. 3. In Fig. 4 the fluid tank is shown from the inside. Here the inlet 13 and outlet 14 from the inside of the fluid tank 10 are provided with quick connectors 15. Quick connectors 15 can be provided on any one of the inlets /outlets of the fluid tank 10. Thus, it is envisaged that quick connectors can also be provided on the inlet 11 and or the outlet 12.

In Fig. 5 the fluid tank 10 is shown in perspective removed from the air-conditioner 100. The fluid tank 10 comprises at least one filling opening 16, 17. The filling opening 16 in Fig. 5 is provided in a low-pressure side of the circulation system. A filling opening 17 can also be provided in a high-pressure side of the circulating system.

To elaborate, with the pump off – the pressure in the fluid loop of the circulating system and the fluid tank is atmospheric pressure. However, when the pump used to circulate fluid in the loop (of which the fluid tank is a part) is started, it sucks fluid in and discharges it on the other side. As a side-effect; the tank chamber that is on the discharge side is pressurized. The tank chamber on the suction side is under-pressure. Thus, the pressure in the discharge side will have a high pressure compared to the suction side. The terms high-pressure and low-pressure are used herein to reflect this. The pressure difference is caused by the pump pushing fluid through the heat exchanger (pressure drop). A purge valve on the high-pressure side can be used to remove air when the pump is running – because there is a pressure to "push" the air out.

In Fig. 6 a side view of the fluid tank 10 is shown. A top section 20 of the fluid tank 10 is inclined. The high-pressure filling opening 17 and or low-pressure filling opening 16 are in some embodiments located at a top portion of the inclined top section 20. The high-pressure inlet 11, the high-pressure outlet the low-pressure inlet, and the low-pressure outlet are located on side walls of the fluid tank 10. In accordance with some embodiments at least one of the

high-pressure inlet 11, the high-pressure outlet 14, the low-pressure inlet 13, and the low-pressure outlet 12 is inclined in relation to a bottom portion 30 of the fluid tank 10. For example, the inlets/outlets can point slightly in a direction downwards (towards the bottom portion). The inclination can for example be achieved by letting the side walls of the fluid tank 10 be inclined (not being in a 90-degree angle) with respect to the bottom portion 30. In another embodiment the inlets/outlets can be arranged inclined with respect to the side walls of the fluid tank.

In Fig. 7 a cross-sectional view along the section A-A of Fig. 6 is shown. In Fig. 7 the two chambers 50 and 60 inside the fluid tank are shown. A first chamber 60 can be the high-pressure side of the circulating system and the second chamber 50 can be the low-pressure side of the circulating system. For example, the first chamber 60 can be a high-pressure chamber that takes the water (or some other suitable fluid) discharged from a pump which causes pressure buildup. The pressure forces water out of the first chamber 60. The second chamber 50 is a low-pressure chamber from which the pump sucks water out causing a low pressure. The low-pressure sucks water out of second chamber 50. In the embodiment of Fig.7 a filling opening is provided both on the high-pressure side and on the low-pressure side.

In addition, a purge valve can be provided to further facilitate removal of air from the circulating system. In some embodiments a purge valve per chamber 50, 60 can be provided. In one embodiment the purge valve is provided on at least one of the caps of the filling opening(s) 16, 17. In Fig. 8, the high-pressure chamber 60 is shown in across-sectional view from the side with a cap 70 removed from the high-pressure filling opening. On the bottom of the chamber 60 fluid is present. On top of the water air is present. The cap 70 is in the embodiment of Fig. 8 provided with a purge valve 71. When the cap 70 is put in place, air can exit the chamber 60 via the purge valve 71.

When in use the air-conditioner 100 can be operated as follows when filling the circulating system with water (or other fluid). The fluid tank can preferably be placed at a highest position in the circulating system of the air-

conditioner. For example, if the air-conditioner is placed in a window sill as depicted in Fig. 1 the fluid tank can be attached to the windowsill and connected to the circulating system via the inlet and outlet openings of the fluid tank. The filling opening or openings depending on implementation of the fluid tank can then be opened. Water is filled slowly through the opening(s), until water almost overflows. The high-pressure filling opening, if present is then closed and the pump of the circulating system is started. The water level of in the low-pressure chamber then lowers. In accordance with some embodiments the pump of the circulating system can then be cycled on/off. As this process continues air in the circulating system will enter the chambers and can exit the circulating system via the filling opening of the low-pressure side and or via a purge valve. When the water level drops in the low pressure chamber more water can be filled until the water level no longer drops. Then the filling opening of the low-pressure chamber can be closed. The circulating system is now filled with no air therein. If a purge vale is present air that for some reason enters the system can be removed via the purge valve. If no purge valve is present air can be removed be filling water in the filling opening in the same manner as when first filling up the circulating system as a top up filling.

Using the fluid tank as described herein allows for easy filling of a circulating system of an air-conditioner. At the same time the fluid tank allows for easy removal of air from the circulating system.

CLAIMS

1. Fluid tank (10) configured to connect an indoor unit (101) of an air-conditioner (100) with an outdoor unit (102) of the air-conditioner, the fluid tank comprising

- a first chamber (60),

- a second chamber (50),

- the first chamber comprising a high-pressure inlet (11) and a high-pressure outlet (14),

- the second chamber comprising a low-pressure inlet (13), a low-pressure outlet (12) and a low-pressure filling opening (16).

2. The fluid tank according to claim 1, wherein the first chamber comprises a high-pressure filling opening (17).

3. The fluid tank according to claim 1 or 2, wherein a top section (20) of the fluid tank is inclined and wherein the high-pressure filling opening and or low-pressure filling opening are located at a top portion of the inclined top section.

4. The fluid tank according to any one of claims 1 - 3, wherein the high-pressure inlet (11), the high-pressure outlet (14), the low-pressure inlet (13), and the low-pressure outlet (14) are located on side walls of the fluid tank.

5. The fluid tank according to claim 4, wherein at least one of the high-pressure inlet, the high-pressure outlet the low-pressure inlet, and the low-

pressure outlet is inclined in relation to a bottom portion (30) of the fluid tank.

6. The fluid tank according to any one of claims 1 - 5, wherein at least one of the high-pressure inlet, the high-pressure outlet the low-pressure inlet, and the low-pressure outlet are provided with quick connectors (15).

7. The fluid tank according to any one of claims 1 - 6, wherein at least one of the first chamber (60) and the second chamber (50) is provided with a purge valve (71).

8. An air conditioner (100) comprising an indoor unit (101) and an outdoor unit (102), and a circulation system (103) for a non-hazardous fluid circulating between the indoor unit and the outdoor unit, the air conditioner comprising a fluid tank (10) according to any one of claims 1 -7 in the fluid path of the non-hazardous fluid circulating in the circulation system.

9. The air-conditioner according to claim 8, wherein the fluid tank is located at a highest position of the fluid path of the non-hazardous fluid circulated between the indoor unit and the outdoor unit.

10. The air-conditioner according to claim 8 or 9, wherein the fluid circulated between the indoor unit and the outdoor unit is a water-based fluid or an alcohol.

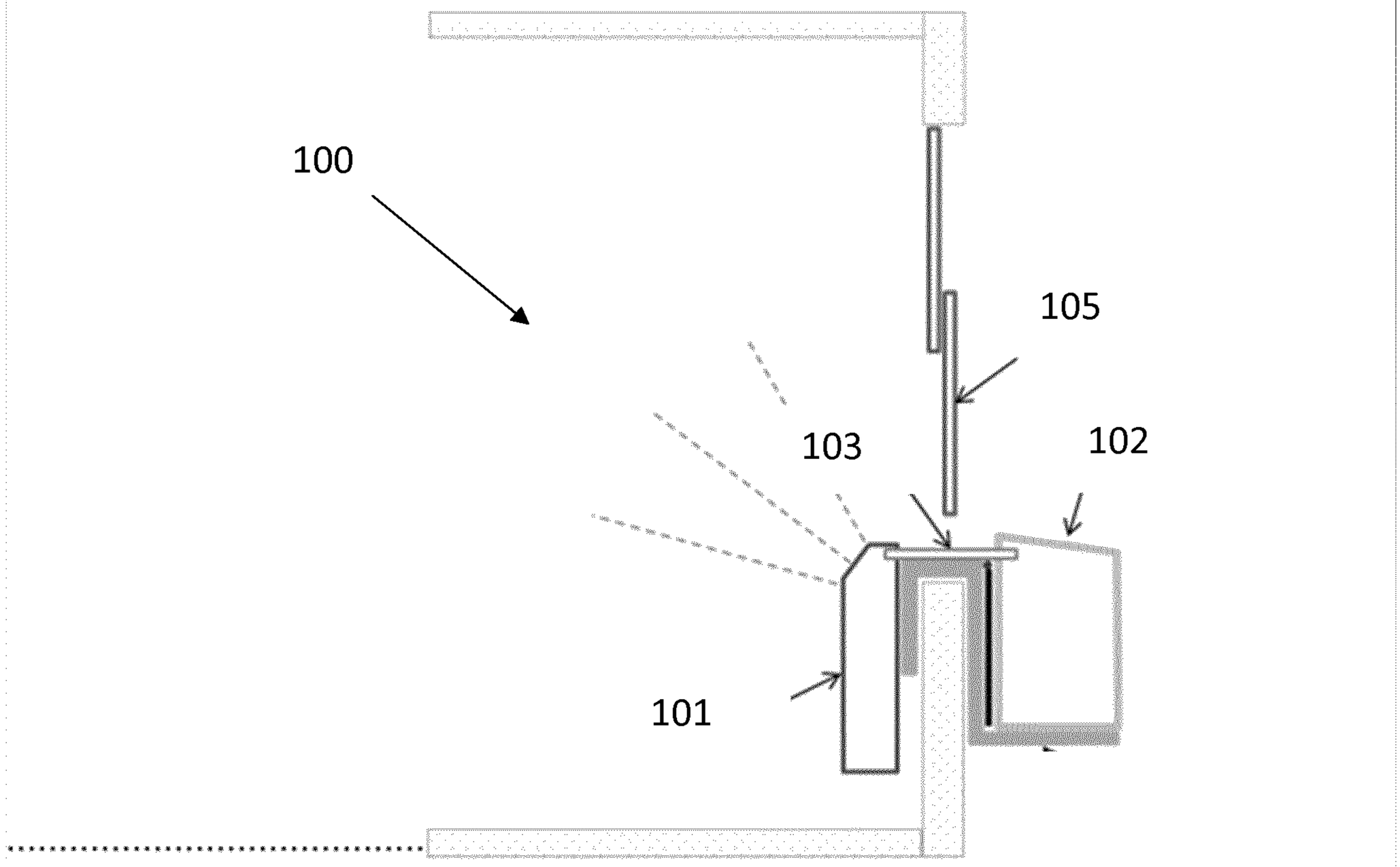


Fig. 1

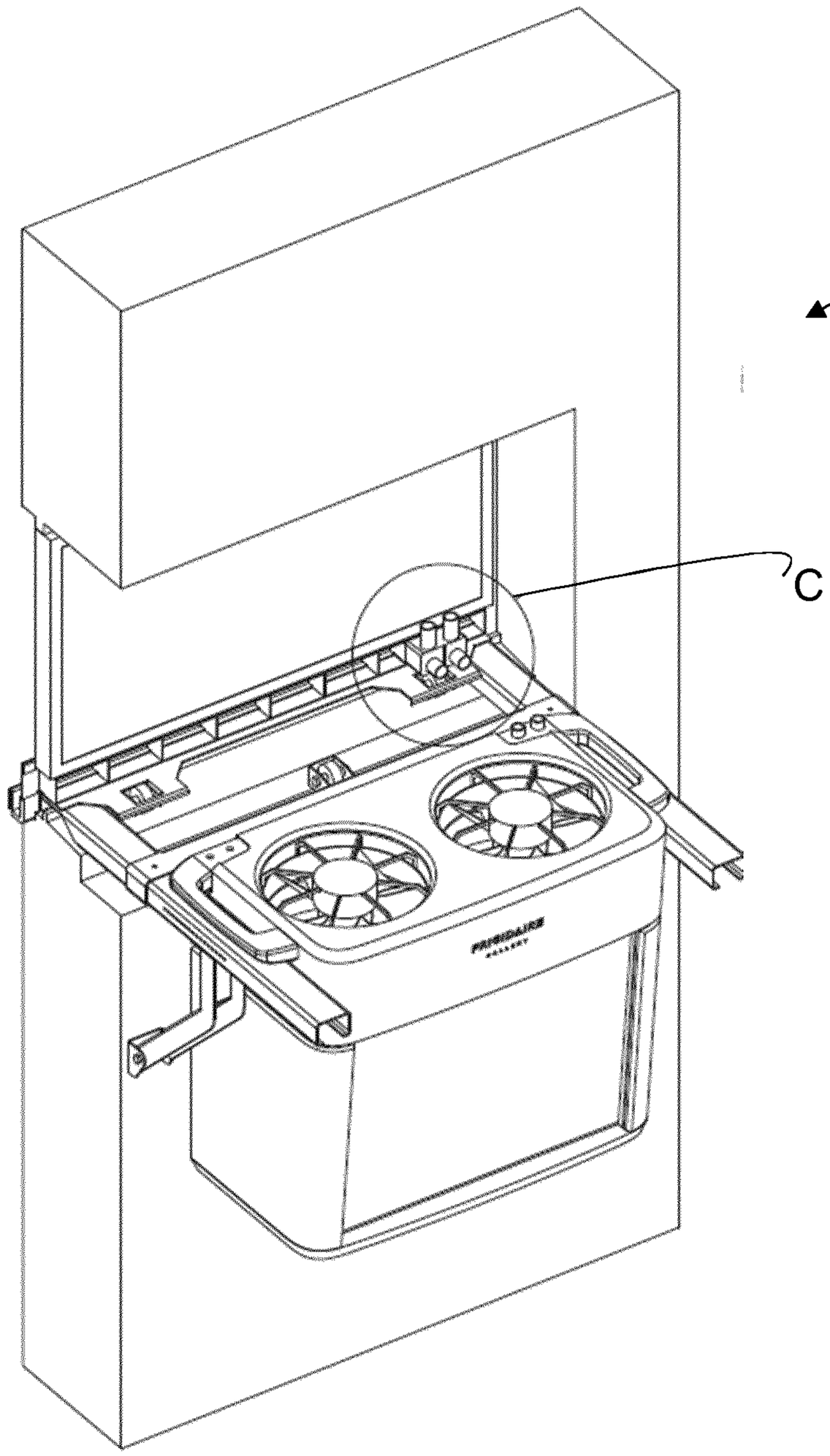


Fig. 2

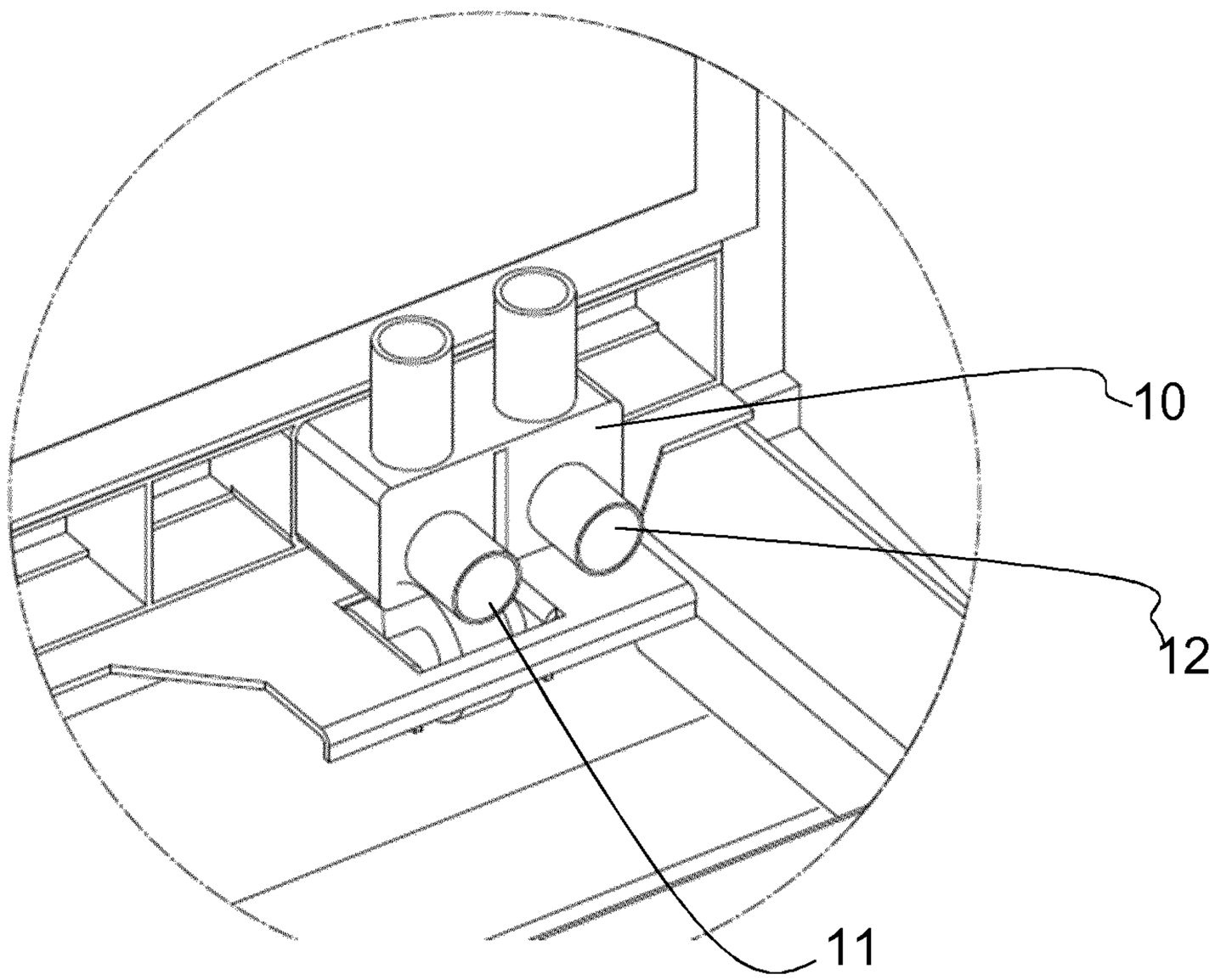


Fig. 3

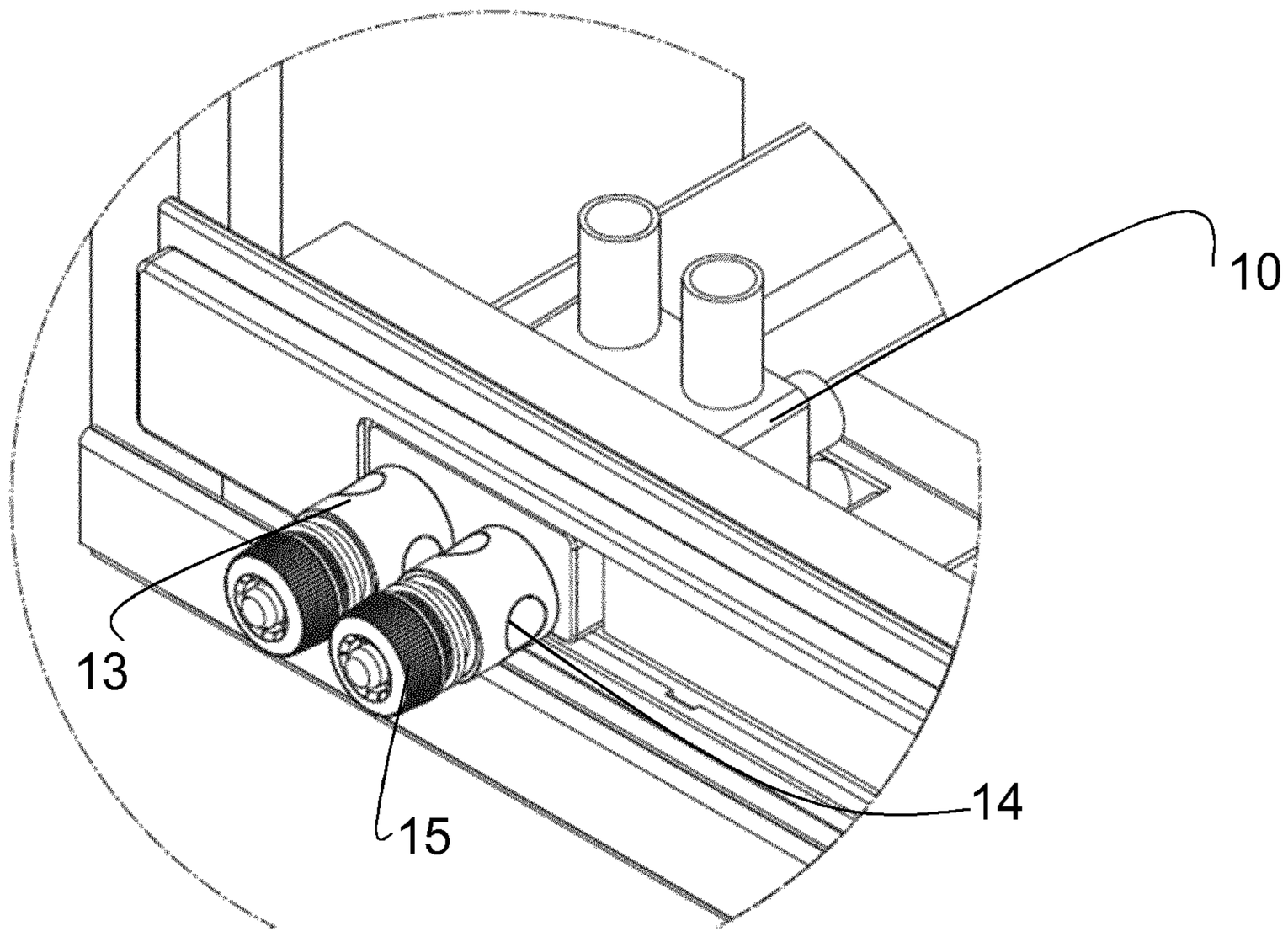


Fig. 4

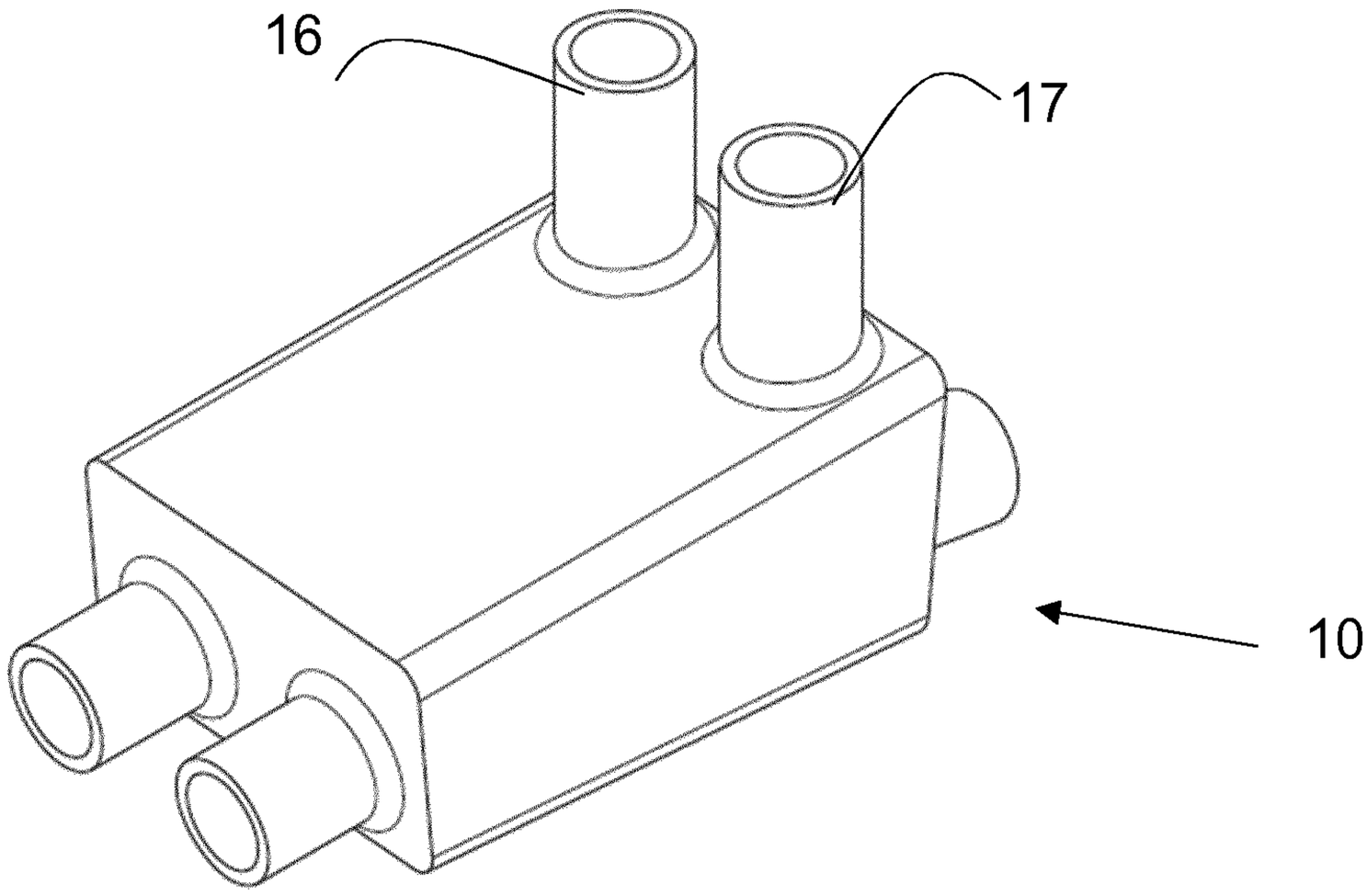


Fig. 5

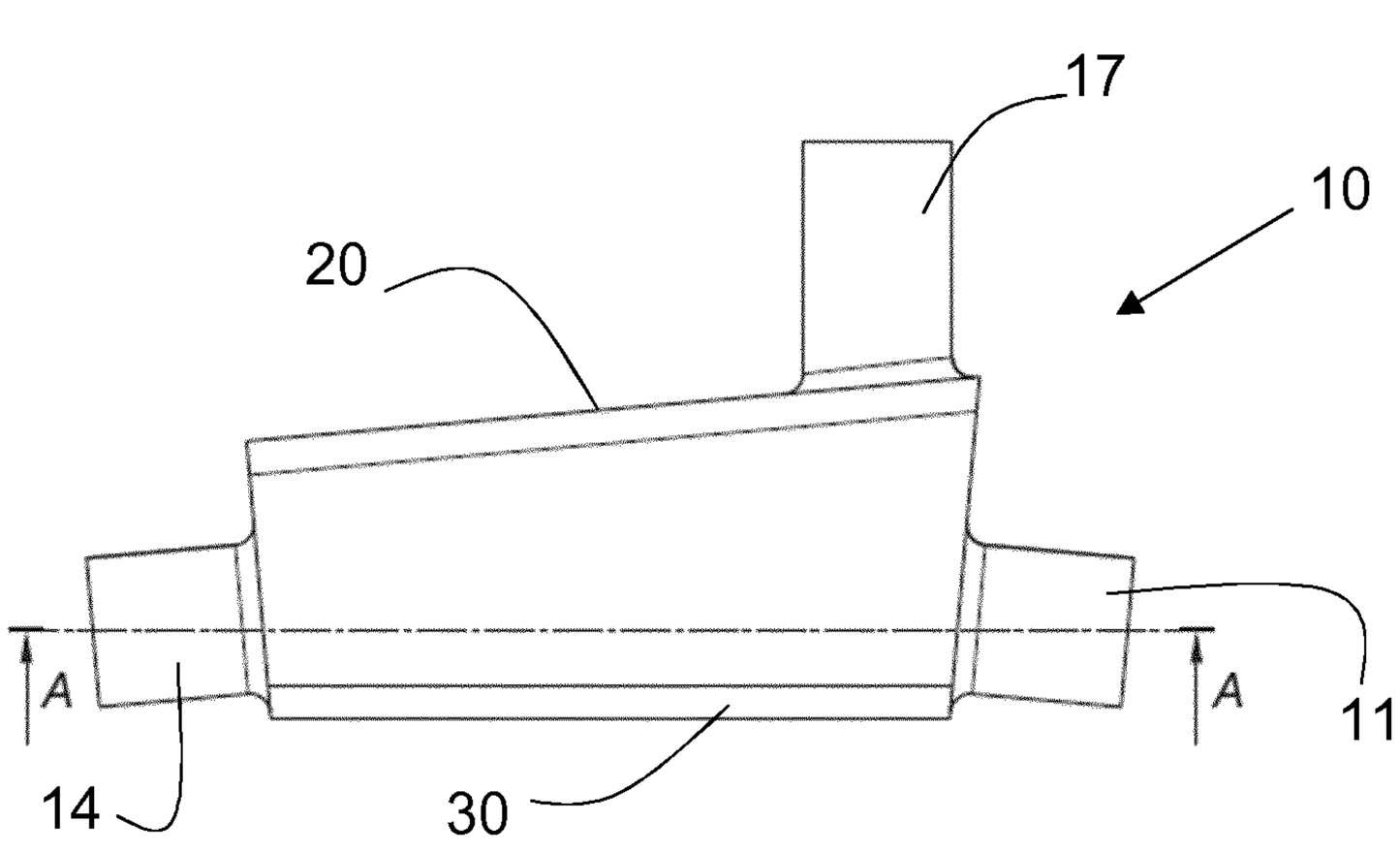


Fig. 6

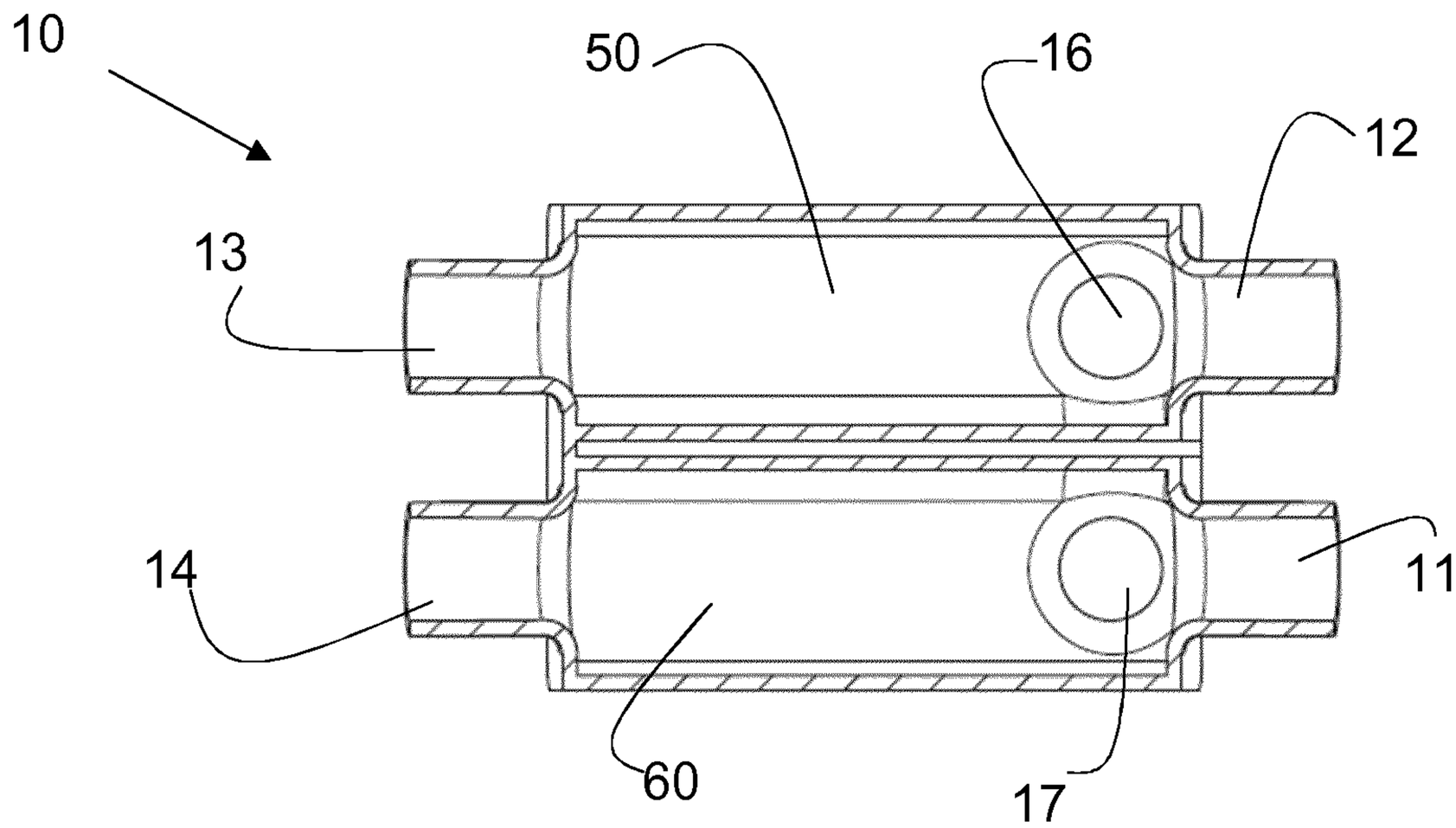


Fig. 7

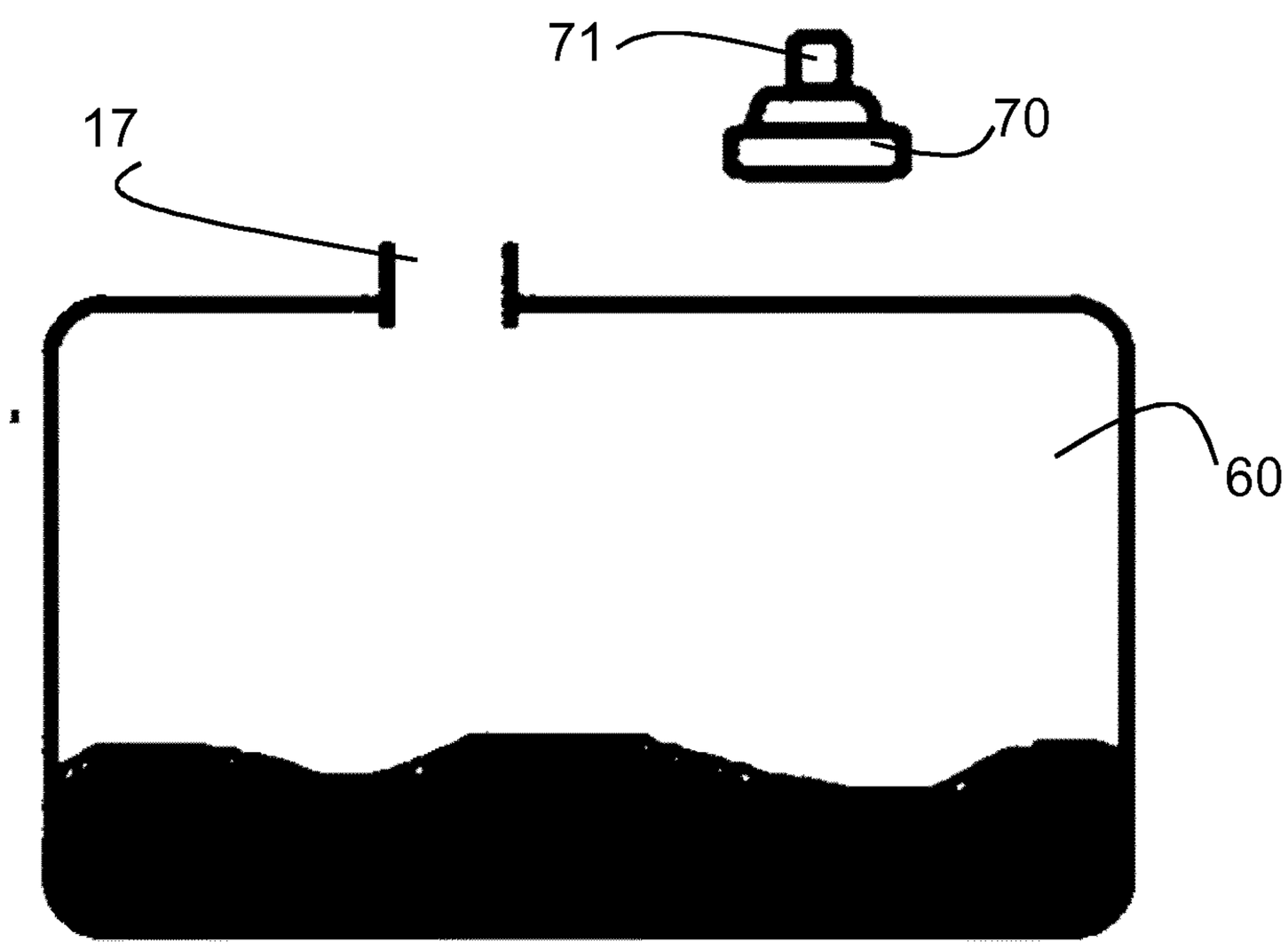


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/083588

A. CLASSIFICATION OF SUBJECT MATTER
INV. F24F1/0003 F24F1/32
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)
F24F

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.
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X	EP 3 312 531 A1 (MITSUBISHI ELECTRIC CORP [JP]) 25 April 2018 (2018-04-25) paragraph [0021] - paragraph [0032] figures -----	1
A	EP 3 276 279 A1 (MITSUBISHI ELECTRIC CORP [JP]) 31 January 2018 (2018-01-31) abstract; figures -----	1-10
A	WO 2019/114944 A1 (ELECTROLUX APPLIANCES AB [SE]) 20 June 2019 (2019-06-20) abstract; figures -----	1-10

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

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
26 August 2020	04/09/2020
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Mattias Grenbäck

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/083588

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 2 381 180 A2 (LG ELECTRONICS INC [KR]) 26 October 2011 (2011-10-26) paragraph [0050] - paragraph [0073] figures -----	1-10

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2019/083588

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