(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 008 965 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.06.2022 Bulletin 2022/23

(21) Application number: **20211475.7**

(22) Date of filing: **03.12.2020**

(51) International Patent Classification (IPC):
F24C 15/20 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F24C 15/2042

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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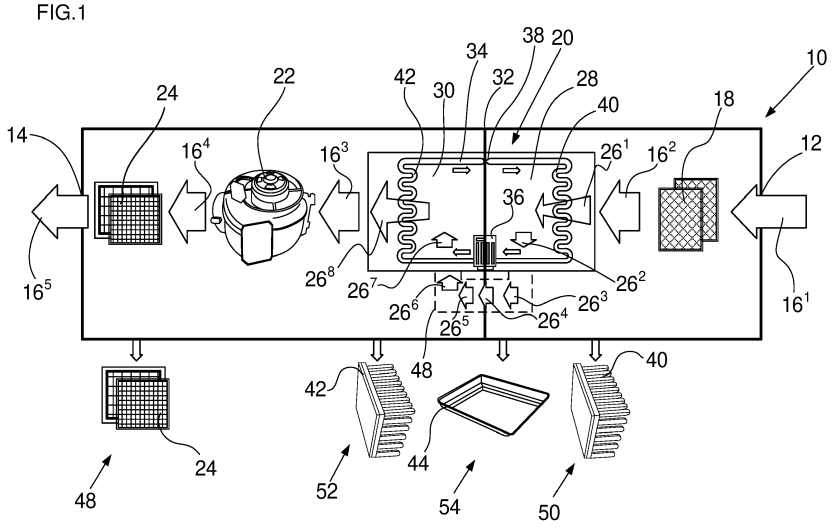
(54) EXTRACTION DEVICE AND METHOD FOR OPERATING THE SAME

(57) An extraction device (10) for removing heated air from an area above a cooking hob comprises
- an inlet opening (12) for an air intake into an interior of the extraction device (10),
- a conduction means for conducting the heated air through the interior of the extraction device (10),
- a fan (22) for sucking-in the heated air from the area above the cooking hob, the fan (22) being arranged in or being in operative connection with the conduction means, and
- an outlet opening (14) for exhausting air.

According to the present invention, a cooling down means (40) for cooling down the heated air and a separation means (40) for a separation of fluid particles from the heated air are arranged upstream of the fan (22), wherein the separation of the fluid particles is particularly an effect of the cooling down process.

Further, a method for operating an extraction device (10) is disclosed. Air loaded with fluid particles is transported from an inlet opening (12) to an outlet opening (14) of the extraction device (10). According to the invention, the fluid particles are separated from the air by benefitting from a condensation effect.

FIG.1



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Description

[0001] The present invention relates to an extraction device for removing heated air from an area above a cooking hob according to the preamble of claim 1. The present invention further relates to a method for operating an extraction device according to the preamble of claim 14.

[0002] During the performance of cooking activities under use of a cooking hob, cooking vapours are generated, which are distributed over the cooking area. In order to avoid these cooking vapours to be spread throughout the entire kitchen space, an arrangement of an extraction device, particularly an extractor hood, is common. Said extraction device is usually operated in parallel to the cooking hob, thereby sucking in those cooking vapours in order to filter out particles and tiny droplets from the vapours and/or to blow the vapours to the outside of the building. While it has been common to arrange such an extractor hood above the cooking area, in recent years downdraft extraction devices have been finding a growing market. Such kind of extraction device is usually arranged below a worktop of the related cooking hob, thereby forming a combination appliance, and it comprises at least one fan for sucking air from the cooking area through an opening or recess arranged in the worktop.

[0003] Commercial combination appliances with a downdraft extraction device usually operate with recirculating air, which is not extracted outside of the installation room or building, but is blown out into the ambient air after it has been filtered. A common order of arrangement of devices is as follows: the air with cooking vapours is aspirated from the cooking zones above the worktop of the cooking hob through the opening or recess, subsequently passing a particle filter, e.g. a grease particle filter. Then, after having passed the fan, the conveyed air passes an odour filter before being blown out through an outlet opening. Due to the air humidity in the exhausted air, which depends on the humidity of the sucked in kitchen vapours, the exhausted air has to be released to the ambient air outside of the kitchen cabinet, because a release in the kitchen cabinet could cause damages thereto. A release in the base area of the kitchen cabinet is common, so that, consequently, an air tube is led through the kitchen cabinet towards a plinth panel of the kitchen cabinet, where an outlet opening is implemented. Such an air tube installation, however, is elaborate and requires space from the interior of the kitchen cabinet. Further, the air humidity of the exhausted air is blown into the installation room, which is usually a kitchen space, so that a cooking process with high steam formation regularly increases the humidity of the room air in an uncontrolled way.

[0004] It is an object of the present invention to provide an extraction device allowing a particular air humidity control along with a low installation complexity. In addition, a method for operating such an extraction device serving the same purpose shall be provided.

[0005] The object is achieved by an extraction device for removing heated air from an area above a cooking hob, which extraction device comprises an inlet opening, a conduction means, a fan and an outlet opening. The inlet opening is suitable or provided for an air intake into an interior of the extraction device. The conduction means, which may be an air duct, is suitable or provided for conducting the heated air through the interior of the extraction device. The fan is suitable or provided for sucking in the heated air from the area above the cooking hob and is arranged in or is in operative connection with the conduction means. The outlet opening is suitable or provided for exhausting air, which exhaustion may take place into room air or ambient air. According to the present invention, a cooling down means for cooling down the heated air and a separation means for a separation of fluid particles from the heated air are arranged upstream of the fan. Said separation of the fluid particles is particularly an effect of the cooling down process and/or the separation means may be a condenser or a condensation surface.

[0006] The fluid particles may be any type of particles having a liquid physical state, but particularly water particles or droplets and/or grease or oil particles are included.

[0007] The extraction device is particularly an extraction hood, more particularly a downdraft extraction hood. The heated air especially comprises cooking vapours.

[0008] Specifically by the separation means, in particular the condenser and/or the condensation surface, supported by the cooling down means, a reduction of humidity of the sucked-in and subsequently cooled heated air is achieved and the air may be blown out in the interior of a kitchen cabinet, so that an extended tubing inside of the kitchen cabinet can be avoided.

[0009] The cooling down means and the separation means may basically be arranged as an attachment unit, which performs a separation of the fluid particles before the cooking vapours enter the extraction device, i. e. before passing through the inlet opening. Preferably, however, the cooling down means and the separation means are arranged downstream of the inlet opening, which allows an obtrusive and protected accommodation. More preferably, the cooling down means and the separation means are arranged further down the air passage, notably downstream of a filter element, which is arranged at or downstream of the inlet opening, the filter element particularly being a grease filter element, preferably a mesh filter. With such kind of usually easy to clean filter element, quite a number of particles, especially grease particles, are filtered out and do not encounter the cooling down means and separation means.

[0010] According to an embodiment, a heating up means for heating up, notably for reheating, the cooled air is included in the extraction device, too. Such heating up, specifically reheating, of the conveyed air increases its absorption capacity for humidity, so that condensation processes on the continued route of the conveyed air

can be avoided. The heating up means preferably being arranged upstream of the fan, particularly in order to avoid such condensation inside of a housing of the fan.

[0011] In particular, at least one of the cooling down means and the heating up means comprises a heat exchanger. Said heat exchanger may transmit thermal energy to or from another medium. Preferably, the cooling down means and the heating up means are components of a heat pump unit, which is a particularly efficient heat exchanger unit.

[0012] According to specific embodiments, the heat pump unit further comprises a coolant circuit including a compressor means and an evaporator means.

[0013] The extraction device may be further characterized by a collecting device for receiving the separated fluid particles. That way, said separated fluid particles, which particularly include a relevant portion of condensed water, may not be allowed disappearing in an uncontrolled way. In particular, the collecting device is a drip tray, which may be removable from the extraction device for its emptying.

[0014] According to one embodiment, at least two of the cooling down means, the heating up means and the collection device are connected, particularly inextricably connected, to each other, notably for a joint handling of such kind of couple or triple. Alternatively, or additionally, an integral design thereof may be provided.

[0015] An advantageous embodiment of the present invention provides for an extraction device having a carbon filter element, which is arranged downstream of the cooling down means and the separation means and which may be implemented as an odour filter means. Moreover, the carbon filter is preferably arranged also downstream of the heating up means, and more preferably downstream of the fan. The arrangement of the carbon filter downstream of at least the cooling down means is favourable with respect to an increased standing thereof due to it being impacted by merely a low level of humidity and fat or oil in the conveyed air, so that its filtering capacity is reduced relatively slowly over time.

[0016] Favourably, the carbon filter is arranged upstream of the outlet opening, preferably immediately upstream of the outlet opening. That way, service operations on the carbon filter may be facilitated by a simplified access. Such service operations may include a refreshment thereof. To this end, the carbon filter element may be configured to be separately refreshed, in particular in an oven.

[0017] One specific extraction device is designed in that way that the outlet opening is arrangeable inside of a cabinet, in particular a kitchen cabinet. The result of this design and/or arrangement is a release of air into the cabinet, rather than directly into the kitchen room. Due to the released air having a particularly low level of steam or humidity and particularly having an increased temperature, and more particularly having a low level of odours, such release within the interior of the kitchen cabinet is unobjectionable.

[0018] At least one of the cooling down means, the heating up means and the collecting device may be configured to be individually cleaned, preferably in a dishwasher. If the above-mentioned connection, particularly the inextricable connection, of at least two of these components is provided, said connection of components or one-component solution may then be handled in conjunction.

[0019] According to one specific embodiment, a sensor means is provided, which is configured to detect an anomalous condition in the interior of the extraction device. Such anomalous condition may be a fire outbreak, notably on a cooking zone, which may propagate due to the operation of the fan of the extraction device and, in this respect, which may also enter an air channel of the extraction device. The sensor means is in particular a temperature sensor sensing an exceeding temperature rise due to said entrance of flames. The sensor means may also be a light sensor, provided in addition or as an alternative to the temperature sensor, which is configured to detect said entrance of flames due to an exceptional illumination of the interior of the extraction device.

[0020] The risk of the aforementioned fire outbreak is notably present in kitchens, in which greasy cooking is commonly performed. This is particularly the case in so-called wet kitchens, which are common e. g. in Asian territories. In these areas, extraction hoods are usually arranged above cooking zones, what naturally increases the negative impact of flame entrance, so that specific hoods have to be provided in those kitchens. It is for this reason favourable to consider a provision of a downdraft extraction hood, notably including said sensor means, in order to reduce the risk of fire, more specifically the risk of fire propagation.

[0021] Another operation site for aforementioned extraction devices with sensor means may be professional or commercial kitchens. At such locations powerful extraction hoods are installed in order to deal with particularly high temperature and humidity, as well as with kitchen vapours containing a respective amount of grease particles.

[0022] The extraction device may further comprise a control means, which is configured to stop the operation of the extraction device or to disconnect the extraction device from the power supply in case of a detection of an anomalous condition in the interior of the extraction device. Said control means is especially a safety control means. More specifically, the control means stops the operation of the fan if said anomalous condition occurs. By this means, said fire propagation may be stopped as a result of the stop of the operation of the fan.

[0023] The object is also achieved by a method for operating an extraction device, wherein air loaded with fluid particles is transported from an inlet opening to an outlet opening. According to the present invention, the fluid particles are separated from the air by benefitting from a condensation effect. Said condensation effect specifically reduces the absorption capacity for humidity, thereby

supporting the separation of the fluid particles.

[0024] The fluid particles may be any type of particles having a liquid physical state, but particularly water particles or droplets and/or grease or oil particles are included.

[0025] The extraction device, which may be an extraction device according to anyone of the above-described embodiments, is particularly an extraction hood, more particularly a downdraft extraction hood. The heated air particularly comprises cooking vapours.

[0026] One embodiment of the method according to the present invention is characterized in that during its transportation from the inlet opening to the outlet opening the air is cooled down, thereby promoting or causing the condensation effect, and subsequently heated up with a reduced content of fluid particles.

[0027] Novel and inventive features of the present invention are set forth in the appended claims.

[0028] The present invention will be described in further detail with reference to the drawing, in which

Fig. 1 illustrates a schematic diagram of the arrangement of components of an extraction device, also showing an air-flow through this device.

[0029] According to Fig. 1 an extraction device 10 for removing heated air from an area above a cooking hob is provided. The illustration according to Fig. 1 is merely a schematic diagram, rather than to be a representation of a detailed embodiment of a specific extraction device 10. The extraction device 10 in reality may be an extraction hood, e. g. a kitchen hood, of any type, however, a preferred embodiment is provided by a downdraft extraction device, which is particularly arranged below the cooking hob and which more particularly forms a combination appliance together with the cooking hob.

[0030] The extraction device 10 comprises an inlet opening, indicated by 12, for an intake of heated air, particularly cooking vapours sourcing from a cooking process, as well as an outlet opening, indicated by 14, for blowing out exhaust air into ambient air, which may be the air in the interior of a kitchen cabinet in the case of a downdraft extraction device. The airflow in the interior of the extraction device 10 is indicated by arrows 16^1 to 16^5, wherein 16^1 represents the sucked-in heated air at its entry into the extraction device 10 through the inlet opening 12 and 16^5 represents the blown-out exhaust air at its exit from the extraction device 10 through the outlet opening 14. The airflow, i. e. the conveyed air, is conducted through an air channel, which is not shown in detail in Fig. 1.

[0031] After its entry into the air channel of the extraction device 10 (see arrow 16^1), the conveyed air passes through a grease filter system, represented by two mesh-like flat filter elements 18, which is configured to filter out grease or oil droplets that are usually included in specific cooking vapours. That way, the major part of grease or oil comprised in the conveyed air is already removed therefrom and only grease or oil vapours remain.

[0032] After having passed the grease filter system 18, the conveyed air enters a heat pump unit 20 (see arrow 16^2), which unit 20 and a respective airflow therethrough will be explained in more detail further down below.

[0033] The conveyed air leaving the heat pump unit 20 moves further (see arrow 16^3) to a fan 22, which is arranged for sucking in the heated air, e. g. the cooking vapours, for providing the airflow through the air channel of the extraction device 10 and for blowing out the exhaust air into the ambient air. To this end, a fan housing is arranged in the air channel.

[0034] The fan 22 further transports (see arrow 16^4) the conveyed air to an odour filter system, represented by carbon filter elements 24, for removing odours from the conveyed air before the re-entry of the exhausted air into ambient air (see arrow 16^5) through outlet opening 14.

[0035] Turning now to the details about the heat pump unit 20, which is included in the air channel of the extraction device 10 and which forms a relevant element of the present inventive concept. The heat pump unit 20 is configured and provided for a relevant extraction of water and grease or oil from the cooking vapours sucked in by the fan 22 and particularly from the conveyed air, which is already exempt from the grease or oil droplets filtered out by the grease filter 18. As already indicated above, the heat pump unit 20 is implemented in the airflow through the entire extraction device 10, wherein the supply of the heat pump unit 20 with the conveyed air is indicated by arrow 16^2 and the exit is indicated by arrow 16^3. Internal airflow through the heat pump unit 20 is indicated by arrows 26^1 to 26^8, wherein a temperature level is illustrated by the sizes of the different arrows in Fig. 1 and a temperature gradient is indicated by growing or declining arrow shapes. The size of the arrows 26^1 to 26^8 also fit together with the size of the arrows 16^1 to 16^5, so that it is generally visible in Fig. 1 that after its entry into the heat pump unit 20 the temperature of the air is decreased, while the temperature is increased before leaving the heat pump unit 20.

[0036] The heat pump unit 20 basically includes two compartments, which are a cold area heat exchanger compartment 28 and a hot area heat exchanger compartment 30. The two compartments 28, 30 are separated by a border 32 and a common coolant circuit 34 is arranged in both compartments 28, 30 and penetrates said border 32. The border 32 may comprise an insulation means, e. g. an insulation layer, for an improved insulation effect between the compartments 28, 30. Further, a compressor unit 36 at a first penetration area and an evaporator, designed as vaporization line 38, at a second penetration area are implemented in the coolant circuit 34. When passing through the compressor 36, the coolant is compressed and heated by the applied pressure, so that hot coolant flows through the coolant circuit in the hot area heat exchanger compartment 30, and when passing through the vaporization line 38, the coolant is

expanded during a vaporization process and cooled down, so that cold coolant flows through the coolant circuit in the cold area heat exchanger compartment 28. A cold area heat exchanger 40 forms or is arranged at a middle part of the coolant circuit 34 in the cold area heat exchanger compartment 28, and a hot area heat exchanger 42 forms or is arranged at a middle part of the coolant circuit 34 in the hot area heat exchanger compartment 30. Both cold and hot area heat exchangers 40, 42 are symbolized in the coolant circuit 34 in Fig. 1 as serpentine sections.

[0037] As mentioned above, the airflow through the heat pump unit 20 is illustrated by arrows 26^1 to 26^8 and is integrated in the airflow in the interior of the extraction device 10 between arrows 16^2 and 16^3, so that the entire airflow and related conditions are explained as follows. Heated air including humidity, or steam respectively, and grease or oil enters the extraction device 10 by arrow 16^1 and passes through the grease filter elements 18, which may be a mash filter. By arrow 16^2, the heated air with reduced humidity and grease or oil enters the heat pump unit 20 and is forwarded therein to the cold area heat exchanger compartment 28, where it is cooled down by the cold area heat exchanger 40 (arrow 26^1). Major portions of the humidity and grease or oil condense on the cold area heat exchanger 40 and the condensed particles are collected in a drip tray 44 positioned beneath the cold area heat exchanger 40. Thereafter, the cooled air is conducted through a bypass duct 46 (arrows 26^3 to 26^6) that is indicated in Fig. 1 by dotted lines, thereby bypassing the border 32 between cold area heat exchanger compartment 28 and hot area heat exchanger compartment 30. Then the cooled air with only remaining small amounts of humidity and grease or oil enters the hot area heat exchanger compartment 30 (arrow 26^6) and is heated up again therein by the hot area heat exchanger (42, arrow 26^8). Hot air is adapted to carry a higher amount of humidity, what avoids condensation or fog formation. The re-heated air with a low level of humidity leaves the heat pump unit 20 and is forwarded to fan 22 by arrow 16^3 and from fan 22 to carbon filter elements 24 by arrow 16^4. When having passed through the carbon filter elements 24 the re-heated air with a low level of humidity and odour exits from the extraction device 10 through the outlet opening 14 and enters the interior of the kitchen cabinet.

[0038] Finally, some components are removable from their installation positions. The indication 48 of a removal of the carbon filter elements 24 from the extraction device 10 shall illustrate that these filter elements 24 are detachable for their refreshment, e. g. in an oven. Similarly, the indications 50, 52, 54 of a removal of the cold area heat exchanger 40, of the hot area heat exchanger 42 and of the drip tray 44 from the extraction device 10 shall illustrate that all these components 40, 42, 44 are detachable for their cleaning, e. g. in a dishwasher. Indications 50 and 52 also illustrate the design of real embodiments of cold and hot area heat exchangers 40 and 42, which are only symbolized as serpentine sections in the coolant circuit 34, as mentioned above.

[0039] In order to realize above-described removability of the cold and hot area heat exchangers 40 and 42, these components may be designed as moulded parts, particularly made of aluminium. These moulded parts may be connected to the respective sections of the coolant circuit conduit by surface pressure, which also cares for a particularly great thermal conductivity. It is favourable to provide for large surface areas, both with respect to the connection between coolant circuit conduit and cold or hot area heat exchangers 40, 42 and with respect to the crossover from cooling fins to ambient air. The removal of the cold and hot area heat exchangers 40, 42 from the extraction device 10 is executed by disengaging their press-fitting connections with the coolant circuit conduit. That way, the cold and hot area heat exchangers 40, 42 are removable for their cleaning, while the closed conduit of the coolant circuit 34 remains in the extraction device 10.

[0040] Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to these precise embodiments, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention. All such changes and modifications are intended to be included within the scope of the invention as defined by the appended claims.

List of reference numerals

[0041]

10	extraction device
12	inlet opening
14	outlet opening
16^1 ... 16^5	arrows for airflow through the extraction device
18	flat filter elements
20	heat pump unit
22	fan
24	carbon filter elements
26^1 ... 26^8	arrows for airflow through the heat pump unit
28	cold area heat exchanger compartment
30	hot area heat exchanger compartment
32	border
34	coolant circuit
36	compressor unit
38	vaporization line
40	cold area heat exchanger
42	hot area heat exchanger
44	drip tray
46	bypass duct
48	indication of removal of the carbon filter elements

50 indication of removal of the cold area heat exchanger
52 indication of removal of the hot area heat exchanger
54 indication of removal of the drip tray

Claims

1. An extraction device (10) for removing heated air from an area above a cooking hob, the extraction device (10) particularly being an extraction hood, more particularly a downdraft extraction hood, the heated air particularly comprising cooking vapours, the extraction device (10) comprising

- an inlet opening (12) for an air intake into an interior of the extraction device (10),
- a conduction means, particularly an air duct, for conducting the heated air through the interior of the extraction device (12),
- a fan (22) for sucking-in the heated air from the area above the cooking hob, the fan (22) being arranged in or being in operative connection with the conduction means, and
- an outlet opening (14) for exhausting air, in particular into room air or ambient air,

characterized in that
a cooling down means (40) for cooling down the heated air and a separation means (40), particularly a condenser or a condensation surface, for a separation of fluid particles, particularly water particles or droplets and/or grease or oil particles, from the heated air are arranged upstream of the fan (22), wherein the separation of the fluid particles is particularly an effect of the cooling down process.

2. The extraction device (10) according to claim 1,
characterized in that
the cooling down means (40) and the separation means (40) are arranged downstream of the inlet opening (12), preferably downstream of a filter element (18), which is arranged at or downstream of the inlet opening (12), the filter element (18) particularly being a grease filter element, preferably a mesh filter.

3. The extraction device (10) according to claim 1 or 2,
characterized by
a heating up means (42) for heating up, notably for reheating, the cooled air, the heating up means (42) preferably being arranged upstream of the fan (22).

4. The extraction device (10) according to anyone of the preceding claims,
characterized in that
at least one of the cooling down means (40) and the heating up means (42) comprises a heat exchanger.

5. The extraction device (10) according to claim 4,
characterized in that
the cooling down means (40) and the heating up means (42) are components of a heat pump unit (20), wherein in particular the heat pump unit (20) further comprises a coolant circuit (34) including a compressor means (36) and an evaporator means (38).

6. The extraction device (10) according to anyone of the preceding claims,
characterized by
a collecting device (44), in particular a drip tray, for receiving the separated fluid particles.

7. The extraction device (10) according to claim 6,
characterized in that
at least two of

- the cooling down means (40),
- the heating up means (42), and - the collection device (44) are connected, particularly inextricably connected, to each other or integrally designed.

8. The extraction device (10) according to anyone of the preceding claims,
characterized in that
a carbon filter element (24) is arranged downstream of the cooling down means (40) and the separation means (40), preferably downstream of the heating up means (42), more preferably downstream of the fan (22), the carbon filter element (24) particularly being arranged upstream of the outlet opening (14), preferably directly upstream of the outlet opening (14) .

9. The extraction device (10) according to claim 8,
characterized in that
the carbon filter element (24) is configured to be separately refreshed, in particular in an oven.

10. The extraction device (10) according to anyone of the preceding claims,
characterized in that
the extraction device (10) is designed **in that** way that the outlet opening (14) is arrangeable inside of a cabinet, in particular a kitchen cabinet.

11. The extraction device (10) according to anyone of the preceding claims,
characterized in that
at least one of the cooling down means (40), the heating up means (42) and the collecting device (44) is configured to be individually cleaned, preferably in a dishwasher.

12. The extraction device (10) according to anyone of the preceding claims,
characterized by
a sensor means configured to detect an anomalous condition in the interior of the extraction device (10), the sensor means in particular being a temperature sensor and/or a light sensor.

13. The extraction device (10) according to claim 12,
characterized by
a control means, in particular a safety control means, which is configured to stop the operation of the extraction device (10), in particular the operation of the fan (22), or to disconnect the extraction device (10) from the power supply, in case of a detection of an anomalous condition in the interior of the extraction device (10).

14. A method for operating an extraction device (10), particularly an extraction hood, more particularly a downdraft extraction hood, in particular an extraction device according to anyone of the preceding claims, wherein air loaded with fluid particles, particularly water particles or droplets and/or grease or oil particles, is transported from an inlet opening to an outlet opening,
characterized in that
the fluid particles are separated from the air by benefitting from a condensation effect.

15. The method according to claim 14,
characterized in that
during its transportation from the inlet opening (12) to the outlet opening (14) the air is cooled down, thereby promoting or causing the condensation effect, and subsequently heated up with a reduced content of fluid particles.

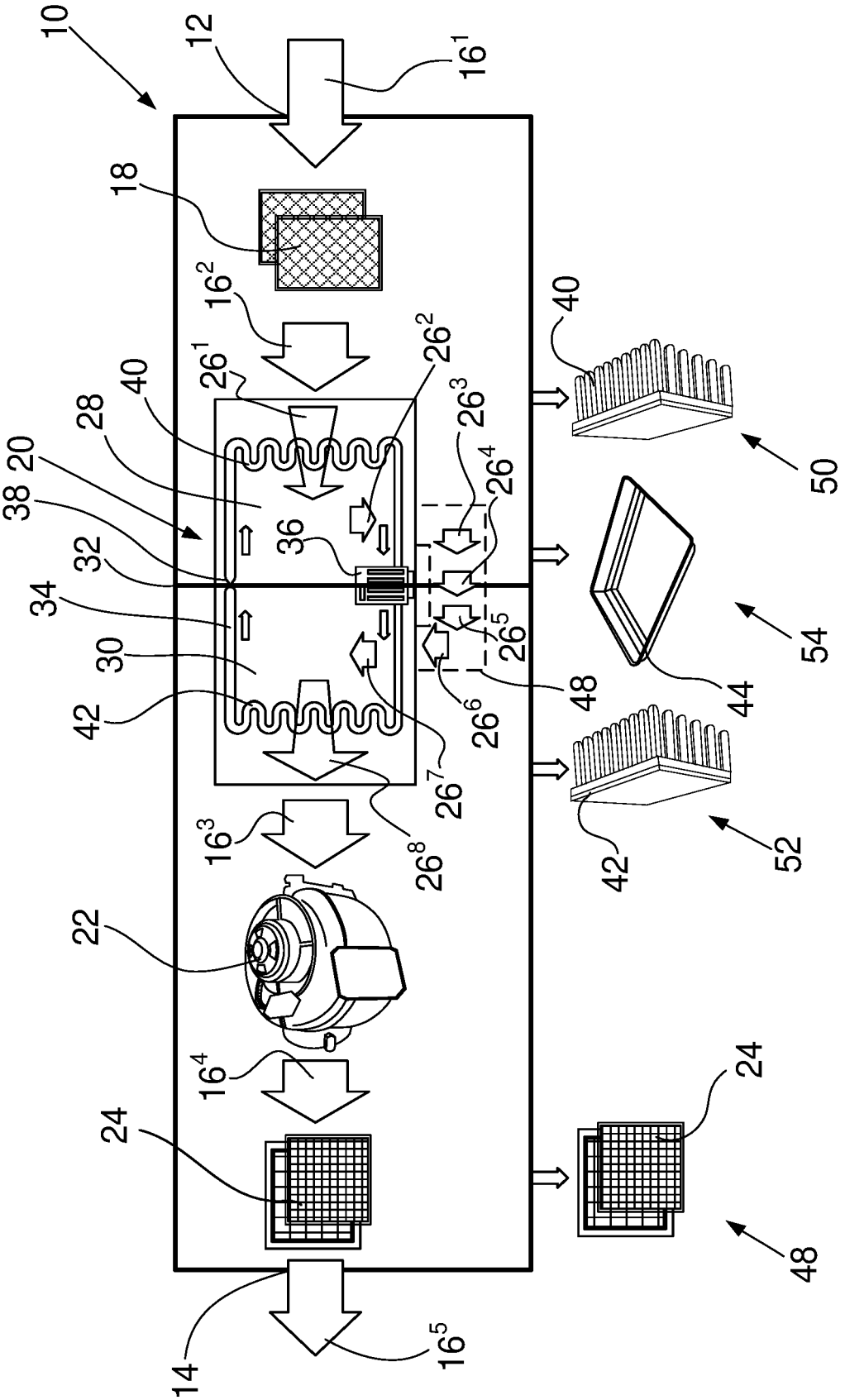
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FIG.1

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EUROPEAN SEARCH REPORT

Application Number
EP 20 21 1475

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F24C
B01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 May 2021	Verdoodt, Luk

CATEGORY OF CITED DOCUMENTS

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