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(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 (71) Applicant: Electrolux Home Products Corporation N.V. 1130 Brussel (BE)	(72) Inventors: • Pillot, Sergio 33080 Porcia (PN) (IT) • Santarossa, Marco 33080 Porcia (PN) (IT) • Sartor, Luciano 33080 Porcia (PN) (IT) (74) Representative: Nardoni, Andrea et al Electrolux Italia S.p.A. Corso Lino Zanussi, 30 33080 Porcia (PN) (IT)
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(54) **Laundry treatment apparatus with heat exchanger cleaning**

(57) The invention relates to a laundry treatment apparatus, in particular dryer or washing machine having a dryer function, comprising a control unit, a laundry treatment chamber for treating laundry using process air, a process air loop for circulating the process air, a heat exchanger (10) arranged in the process air loop for cooling the process air, a hollow element (42) comprising at least one outlet opening (54), wherein the hollow element (42) is in fluid communication with a liquid supply source

and adapted to spray liquid to the heat exchanger (10) by at least one liquid spray from the at least one outlet opening (54) for cleaning the heat exchanger, and an actuator (44) for actuating the hollow element (42) along a cleaning axis (D) such that the heat exchanger (10) is cleaned by at least one liquid spray moving along the heat exchanger (10), characterized in that the hollow element (42) and the actuator (44) are movably coupled so as to define therebetween a variable volume (34a) fluidly connected to the liquid supply source.

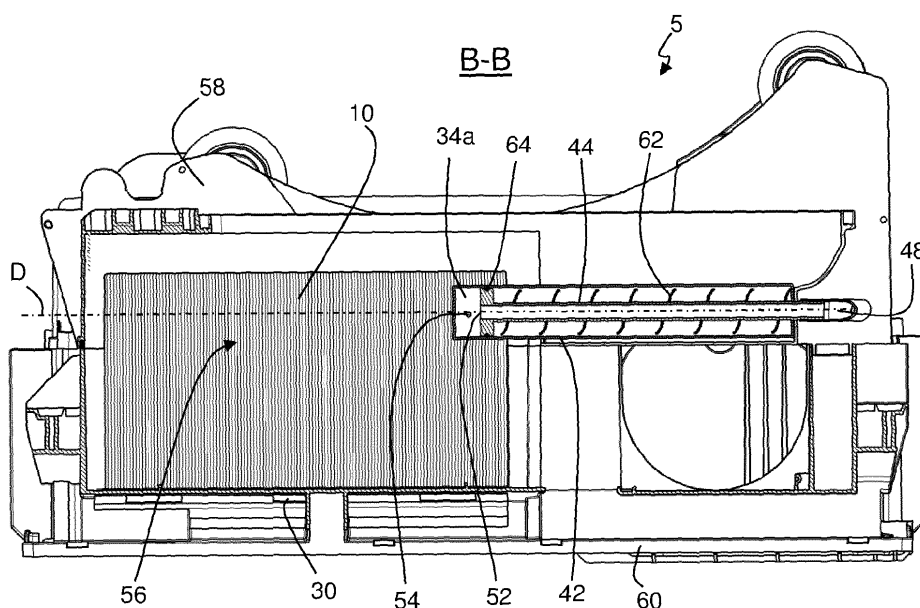


Fig. 7a

Description

[0001] The invention relates to a laundry treatment apparatus, in particular to a dryer or a washing machine having a dryer function, comprising a heat exchanger.

[0002] US 2010/0192398 A1 discloses a dryer comprising a heat exchanger and an elongate injection nozzle element arranged above the heat exchanger. The injection nozzle element comprises a plurality of injection holes along its longitudinal axis. The nozzle is fed with fresh water from a feed pipe, which is connected to the nozzle element via a flexible pipe. According to an embodiment the nozzle element is pivotable about its longitudinal axis within a predetermined angle by means of a driving motor, such that a water spray of the nozzle element is directed towards the heat exchanger for washing off fluff, or such that it forms a water curtain in front of the heat exchanger to collect fluff from the process air before it accumulates on the heat exchanger surface. Alternatively the injection nozzle element is moved along its longitudinal axis by means of a driving motor to assist washing off of fluff from the heat exchanger.

[0003] It is an object of the invention to provide a cost-efficient laundry treatment apparatus which keeps a heat exchanger of the apparatus free from fluff.

[0004] The invention is defined in claim 1. Particular embodiments are set out in the dependent claims.

[0005] According to claim 1 a laundry treatment apparatus, in particular a dryer or a washing machine having a dryer function, comprises a control unit to control operation (e.g. a drying operation) of the apparatus, a laundry treatment chamber for treating laundry using process air, a process air loop for circulating the process air and a heat exchanger arranged in the process air loop for cooling the process air. A hollow element is provided which is adapted to spray liquid to the heat exchanger for cleaning the heat exchanger. The hollow element is in fluid communication with or is connected to a liquid supply source and comprises at least one outlet opening. The one or each outlet opening provides at least one liquid spray in operation, i.e. in a cleaning phase for the heat exchanger.

[0006] An actuator is adapted to actuate the hollow element along a cleaning axis such that the heat exchanger is cleaned by at least one liquid spray from the hollow element moving along the heat exchanger. The hollow element and the actuator are movably coupled so as to define therebetween a variable volume, e.g. a chamber having a variable volume, fluidly connected to the liquid supply source. For example the movable hollow element is a (hollow) cylinder and the actuator comprises a piston arranged in the cylinder. Alternatively the actuator comprises a (hollow) cylinder which houses or receives the hollow (cylinder) element. E.g. when liquid is supplied to the hollow element, i.e. to the variable volume, the size of the variable volume increases and the hollow element is actuated and moves along the cleaning axis together with the at least one outlet opening. In contrast US

2010/0192398 A1, no driving motor is required to move a liquid spray along the heat exchanger. Thus the treatment apparatus provides a cost-efficient solution for keeping the heat exchanger or the apparatus free from fluff.

[0007] In an embodiment the arrangement of the hollow element and the actuator is configured such that the hollow element moves along the cleaning axis in dependency of the liquid pressure in the hollow element or in the variable volume. E.g. in dependency of the liquid supplied to the variable volume the hollow element moves along the axis, whereby the at least one outlet opening, i.e. the corresponding spray(s), moves along the heat exchanger and washes off fluff accumulated thereon.

[0008] Preferably the size of the variable volume depends on the liquid flow through the chamber or through the volume. I.e. the volume of the variable chamber and therefore the deflection or movement of the hollow element (and the at least one outlet opening) along the cleaning axis depends on the liquid flow through the chamber. Alternatively or additionally the size of the volume or chamber is varied in dependency of the liquid pressure. E.g. the higher the liquid pressure the larger the variable volume or chamber, i.e. the larger the deflection of the hollow element along the cleaning axis. Thus the size of the volume and therefore the deflection distance is controllable by controlling the liquid flow rate to and/or the liquid pressure in the chamber or volume. For example the volume size is controlled by means of a pump controlled by the control unit, wherein the pump is fluidly connected to the hollow element.

[0009] The cleaning axis may be arranged parallel or substantially parallel to the heat exchanger. Alternatively or additionally a longitudinal axis of the hollow element is arranged parallel or substantially parallel to the heat exchanger. I.e. when the hollow element is actuated such that it moves along the cleaning axis, the distance between the heat exchanger and the hollow element, in particular the outlet opening(s), remains constant. Thus the liquid spray(s) are uniformly distributed along the axis to the heat exchanger during the cleaning movement.

[0010] Preferably the width of the liquid spray(s) provided by the outlet opening(s) in cleaning axis direction is smaller than the width of the heat exchanger (in cleaning axis direction). The width is for example the spray width in movement direction and at the front surface of the heat exchanger. Instead of providing a broad but weak liquid spray which substantially covers the complete width of the heat exchanger a narrow but powerful liquid spray towards the heat exchanger is provided which even washes off fluff firmly attached to the heat exchanger surface. For example the width of the liquid spray(s) generated by the outlet opening(s) covers at most 1/3, 1/4, 1/5 or 1/6 of the heat exchanger width.

[0011] Preferably the at least one outlet opening is configured to point towards the heat exchanger when moving along the axis. For example the at least one outlet opening points towards an upper portion of the heat exchanger

er, such that liquid distributed to the heat exchanger via the at least one outlet opening first hits the upper portion of the heat exchanger and then flows down the heat exchanger, whereby fluff is washed off the heat exchanger surface. Alternatively at least two or more outlet openings are provided in the hollow element, wherein each outlet opening is adapted to generate a liquid spray directed towards a different portion of the heat exchanger. E.g. a first outlet opening is directed to an upper portion or upper half of the heat exchanger and a second outlet opening is directed to a lower portion or lower half, whereby the heat exchanger is thoroughly cleaned. Preferably each outlet opening is adapted to provide a plurality of liquid sprays to the heat exchanger. Alternatively a plurality of outlet openings is adapted to provide one liquid spray to the heat exchanger.

[0012] The hollow element may be arranged upstream the heat exchanger. For example when a horizontal heat exchanger is provided, i.e. process air passes the heat exchanger horizontally or substantially horizontally, the hollow element and in particular the at least one outlet opening is arranged in front of a vertical front surface or cross section of the heat exchanger which is passed by process air first. For example the hollow element or its longitudinal axis is arranged upstream the heat exchanger parallel or substantially parallel to the front surface at or at about half the height of the heat exchanger, wherein the at least one outlet opening preferably is adapted to provide a liquid spray which covers the complete height of the heat exchanger.

[0013] Preferably the actuator is at least partially (e.g. unidirectionally) operated hydraulically. In an embodiment the hollow element is a (movable) cylinder portion of the actuator and the actuator further comprises a stationary piston. I.e. the stationary piston (part of actuator) is arranged in the movable cylinder (hollow element), wherein the variable volume is arranged between the piston and the cylinder. The stationary piston is e.g. attached or fixed to a housing of the apparatus. Thus when liquid is supplied to the variable volume (to the hollow element) the volume increases, i.e. the cylinder (hollow element) is deflected or moved along the cleaning axis. Alternatively the hollow element is a (movable and hollow) piston portion of the actuator and the actuator comprises a stationary cylinder portion. I.e. the piston portion (hollow element) is movably guided or arranged inside the stationary cylinder portion (part of actuator), wherein the variable volume is located between the piston portion and the stationary cylinder portion. Summarizing the cleaning device for cleaning the heat exchanger comprises an actuator having a stationary element (piston or cylinder) and a movable hollow element (cylinder, piston portion) which are movably coupled to define therebetween the variable volume.

[0014] According to a preferred embodiment the actuator comprises a stationary hollow piston or a stationary hollow cylinder, e.g. a pipe, in fluid communication with the hollow element and connected to the liquid supply

source such that the hollow element is supplied with liquid via the hollow piston. Thus a space saving arrangement is provided in that the actuator acts as a liquid supply line.

[0015] Preferably an aperture or outlet cross section of the hollow piston is larger than the cross section of the at least one outlet opening of the hollow element. In other words the cross section of an inlet to the hollow element or variable volume is larger than the cross section of the outlet of the hollow element (in case of more than one hollow element the 'outlet cross section area is the sum of the areas of the outlet cross sections). Thereby it is provided that pressure is build up in the hollow element or variable volume, i.e. such that the variable volume increases with rising pressure and/or flow rate, whereby the hollow element or outlet opening(s) is moved along the axis.

[0016] According to an alternative embodiment the actuator comprises a stationary piston which is at least partially arranged in the hollow element, wherein the hollow element comprises an inlet opening or a lug configured to be connected to the liquid supply source. Thus the hollow element comprises an inlet as well as an outlet opening for liquid. For example a flexible conduit is arranged between the inlet opening at the hollow element and a fluid connection to the liquid supply source, such that the flexible conduit is configured to move with the hollow element along the cleaning axis. I.e. when liquid is supplied to the hollow element (i.e. to the variable volume) the variable volume increases or decreases as described above such that the hollow element (and outlet opening(s)) move along the cleaning axis. To provide a pressure build-up in the hollow element as described above, preferably the cross section of the inlet opening is larger than the cross section of the at least one outlet opening. In other words the cross section of the at least one outlet opening or the sum of cross-sections of the outlet openings is smaller than the cross section of the inlet opening.

[0017] In an embodiment an elastic element or resetting element is provided which is configured to provide a restoring force (for example a spring bias) such that an initial position of the hollow element is restored after a deflection of the hollow element along the cleaning axis. For example a spring element, like a steel spring or gas spring.

[0018] Preferably the elastic element is part of the actuator and wherein the elastic element is arranged between a or the piston and the hollow element. For example when a movable hollow cylinder receives a stationary piston as described above, an extension spring is attached to a fixed end of the stationary piston and to an opposed end of the movable cylinder (hollow element), wherein the spring is arranged e.g. on the outside of the hollow element. Thus when the hollow element is deflected from an initial position the spring is stretched and load is applied to the spring which in turn provides a restoring force on the hollow element to move the hollow element or cylinder back to its initial position.

[0019] The elastic element may be arranged within the hollow element. Thus the elastic element, e.g. a spring, is protected from contamination or fluff, in particular when the hollow element is arranged in the process air channel upstream the heat exchanger.

[0020] According to an embodiment the cleaning device comprises a stationary piston (part of actuator) with a cylinder and a piston pipe or rod attached thereto. The piston is received in the hollow element, wherein the above described variable volume (chamber) is arranged between the end of the hollow element which comprises the at least one outlet opening and the side of the piston cylinder facing that end. A corresponding second variable volume is provided in the hollow element on the opposite side of the cylinder. I.e. when liquid is fed to the (first) variable volume, the volume increases and the hollow element is moved along the cleaning axis as described above, wherein the second variable volume decreases. When the second volume or chamber is provided with an opening or nozzle to feed liquid thereto, the hollow element can be returned to its initial position after the supply of liquid to the (first) volume has been stopped by feeding liquid to the second volume such that the variable volume increases, whereby the hollow element is moved back to its initial position.

[0021] Preferred the supply source comprises a supply pump or a valve, which is e.g. connected to the hollow element (or hollow piston) via a feed pipe. When the pump is switched on or the valve is opened a cleaning movement is started along the cleaning axis, wherein when the pump is switched off or the valve is closed the hollow element is returned to an initial position, in particular by means of the above described elastic or resetting element.

[0022] Preferably the treatment apparatus comprises a condensate collector for collecting condensate generated by the heat exchanger, wherein the hollow element is (fluidly) connected to the condensate collector, for example via a feed pipe. Thus the heat exchanger is cleaned or washed with condensate, i.e. the fresh water consumption of the treatment apparatus is reduced.

[0023] A filter element may be arranged upstream the hollow element or downstream the condensate collector. Thus fluff is filtered from the collected condensate before it is fed to the hollow element, i.e. the heat exchanger is washed or rinsed with clean water.

[0024] In an embodiment a basement or base section of the apparatus comprises an upper shell and a lower shell to form a portion of the drying circuit where the heat exchanger is arranged. I.e. only two parts have to be assembled to provide a base section or a housing for the heat exchanger which facilitates the assembly of the apparatus and reduces the assembly time.

[0025] Preferred the upper shell comprises a housing for the hollow element and the actuator, such that the hollow element is arranged inside the drying circuit portion formed by the upper and lower shell. Preferably the upper shell and the housing for the hollow element and

the actuator are made in a single-piece construction.

[0026] According to a preferred embodiment the upper shell comprises an elongate connecting aperture for the at least one liquid spray or for the at least one outlet opening moving along the heat exchanger. I.e. the movable hollow element and the actuator are separated or are essentially separated from the process air channel and therefore protected from e.g. fluff. Further the cleaning device, i.e. hollow element and actuator, does not or essentially not disturb the process air flow. E.g. a housing for the hollow element is separately attached to the upper shell or at least a portion of the housing for the hollow element is formed integrally with the upper shell (e.g. side walls), wherein a separate cover provides an airtight seal for the nozzle element in its housing.

[0027] Preferably the upper shell and at least a portion of the housing are made in a single-piece construction. I.e. the upper shell and the housing form a substantially air-tight chamber to prevent or reduce leakage of drying air from the drying circuit.

[0028] Preferred the lower shell forms the condensate collector where a supply pump for supplying liquid or condensate to the hollow element is arranged.

[0029] According to a preferred embodiment a heat pump system is provided for the treatment apparatus as described above. The heat pump system includes a compressor, a first heat exchanger as described above, expansion means and a second heat exchanger, wherein the first heat exchanger is adapted to cool down the drying air and heat up the refrigerant flowing through the heat pump system, the second heat exchanger is adapted to heat up the drying air and cool down the refrigerant and the hollow element is adapted to spray liquid to at least one between the first and second heat exchanger.

[0030] Reference is made in detail to preferred embodiments of the invention, examples of which are illustrated in the accompanying figures, which show:

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|----|---------|--|
| 40 | Fig. 1 | a schematic view of a laundry treatment apparatus, |
| | Fig. 2 | a top view of a basement of a treatment apparatus according to a first embodiment with a cleaning device in an initial position, |
| 45 | Fig. 3 | a top view of the basement of Fig. 2 with the cleaning device in a deflected position, |
| 50 | Fig. 4 | a perspective top view of a lower shell of the basement of Fig. 2, |
| | Fig. 5 | a perspective top view of the basement of Fig. 2, |
| 55 | Fig. 5a | a detail of Fig. 5, |
| | Fig. 6 | a sectional side view of the basement of Fig. 2 in a plane perpendicular to a move- |

ment axis of the cleaning device,

Figs. 7a-c sectional side views of the basement of Fig. 2 in a plane parallel to the movement axis of the cleaning device,

Fig. 8 a sectional side view of a cleaning device according to a second embodiment in a plane parallel to the movement axis of the cleaning device, and

Fig. 9 a sectional side view of the cleaning device of Fig. 8 in a plane perpendicular to the movement axis of the cleaning device.

[0031] Fig. 1 shows a schematically depicted laundry treatment apparatus 2 which in this embodiment is a heat pump tumble dryer. The tumble dryer 2 comprises a heat pump system 4, including a closed refrigerant loop 6 which comprises in the following order of refrigerant flow B: a first heat exchanger 10 acting as evaporator for evaporating the refrigerant and cooling process air, a compressor 14, a second heat exchanger 12 acting as condenser for cooling the refrigerant and heating the process air, and an expansion device 16 from where the refrigerant is returned to the first heat exchanger 10. Together with the refrigerant pipes connecting the components of the heat pump system 4 in series, the heat pump system forms the refrigerant loop 6 through which the refrigerant is circulated by the compressor 14 as indicated by arrow B.

[0032] The process air flow within the treatment apparatus 2 is guided through a compartment 18 of the home appliance 2, i.e. through a compartment for receiving articles to be treated, e.g. a drum 18. The articles to be treated are textiles, laundry 19, clothes, shoes or the like. The process air flow is indicated by arrows A in Fig. 1 and is driven by a process air blower 8. The process air channel 20 guides the process air flow A outside the drum 18 and includes different sections, including the section forming the battery channel 20a in which the first and second heat exchangers 10, 12 are arranged. The process air exiting the second heat exchanger 12 flows into a rear channel 20b in which the process air blower 8 is arranged. The air conveyed by blower 8 is guided upward in a rising channel 20c to the backside of the drum 18. The air exiting the drum 18 through the drum outlet (which is the loading opening of the drum) is filtered by a fluff filter 22 arranged close to the drum outlet in or at the channel 20. The optional fluff filter 22 is arranged in a front channel 20d forming another section of channel 20 which is arranged behind and adjacent the front cover of the dryer 2. The condensate formed at the first heat exchanger is collected and guided to the condensate collector 30.

[0033] The condensate collector 30 is connected via a drain pipe 46, a filter element 24, a drain pump 36, a valve 38 and a drawer pipe 50 to an extractable conden-

sate drawer 40. I.e. the collected condensate can be pumped from the collector 30 to the drawer 40 which is arranged at an upper portion of the apparatus 2 from where it can be comfortably withdrawn and emptied by a user.

[0034] It is a problem in dryers 2 having heat exchangers 10, 12 that fluff or lint which is generated during a drying process accumulates on the surface of the heat exchanger 10 which is passed by process air first. This may happen with or without optional fluff filter 22 being arranged between the drum and the first heat exchanger 10. Lint accumulated on the heat exchanger 10 reduces the efficiency of the heat exchanger 10 and constricts the flow of process air A.

[0035] To remove or wash off accumulated fluff from the surface of the first heat exchanger 10 a cleaning device 41 is provided close to the heat exchanger 10. The condensate collector 30 is connected via the drain pipe 46, the drain pump 36, the valve 38 and a feed pipe 48 to the cleaning device 41, wherein the drain pump 36 and the valve 38 are controlled by a control unit of the apparatus 2. Alternatively a circulation pump 37 (Fig. 2) is provided to pump condensate from the collector 30 to the cleaning device 41 - i.e. the circulation pump 37 is provided additionally to the drain pump 36.

[0036] Fig. 2 shows a top view of a base section 5 or basement of the dryer 2 according to a first embodiment with the cleaning device 41 in an initial or idle position. The cleaning device 41 comprises a movable hollow cylinder 42 which is guided by a stationary (hollow) piston 44 (Fig. 3) received in the cylinder 42. A variable volume chamber 34a-c (Figs. 7a-c) is provided between the hollow cylinder 42 and the stationary piston 44. The hollow cylinder 42 comprises at its end portion a nozzle or outlet 54 which is directed towards the heat exchanger 10. Liquid is supplied to the hollow cylinder 42 or the variable volume 34a-c via the feed pipe 48 and the stationary hollow piston 44 which acts as a liquid supply line. When liquid pressure raises in the variable volume 34a-c or the hollow cylinder 42, respectively, the hollow cylinder 42 moves along a movement or cleaning axis D while at the same time the outlet 54 generates a liquid spray which sweeps along the heat exchanger 10. Thereby the heat exchanger 10 is cleaned, i.e. fluff is washed off.

[0037] Fig. 3 shows a top view of the basement of Fig. 2 with the cylinder 42 in a maximum deflected position. I.e. the liquid pressure in the variable volume 34a-c has pushed the movable cylinder 42 along the axis D to an end position. Thus the complete width of the heat exchanger 10 (in direction of axis D) has been washed by the liquid spray of the outlet 54.

[0038] The basement 5 houses amongst others the heat exchangers 10, 12 and is formed by a lower shell 60 and an upper shell 58. Fig. 4 shows a perspective top view of the lower shell 60 of the basement 5 of Fig. 2. As described above condensate from the condensate collector 30 or tray is pumped by means of the circulation pump 37 and via the feed pipe 48 to the hollow cylinder

42. The cleaning axis D is arranged parallel to a vertical front surface 54 of the heat exchanger 10, such that the distance between the front surface 54 and the outlet 54 or nozzle of the cylinder 42 is constant during the cleaning movement.

[0039] Fig. 5 shows a perspective top view of the basement 5 of Fig. 2 and Fig. 5a a detail of the cleaning device 41 of Fig. 5. The cylinder 42 is depicted in its initial position where the nozzle outlet 54 is directed to an outer edge or side (right side in the depicted embodiment) of the heat exchanger 10 such that a liquid spray from the outlet 54 washes or cleans the heat exchanger starting from the outer edge. Correspondingly the end position of the cylinder 42 is such that the opening 54 or at least the liquid spray reaches the opposite outer edge or side of the heat exchanger 10, such that the complete width of the heat exchanger (in direction of axis D), i.e. the complete front surface 54, is cleaned by the liquid spray.

[0040] Fig. 6 shows a sectional side view of the basement 5 of Fig. 2 along the line A-A perpendicular to the movement axis D of the hollow cylinder 42. The cleaning device 41, i.e. the movable cylinder 42 and the stationary piston 44, is arranged in the front channel 20d upstream and in front of the heat exchanger 10. The nozzle or outlet 54 points to a front surface 56 or cross section of the heat exchanger 10 where the process air coming from the drum passes first the heat exchanger 10. Thus at least some fluff conveyed by the process air from the laundry in the drum accumulates on the front surface 56. The nozzle 54 is adapted to generate a liquid spray which covers an upper portion of the heat exchanger 10 or front surface 56, wherein the liquid distributed to the heat exchanger 10 flows down the heat exchanger 10 and washes off fluff towards the condensate collector 30 or tray below the heat exchanger 10. As described above the collected condensate is circulated with the circulation pump 37 back to the cleaning device 41 to be used again for cleaning the heat exchanger 10, wherein the condensate is filtered by the filter element 24 before it is fed to the hollow element 42.

[0041] Figs. 7a-c show sectional side views of the basement 5 of Fig. 2 along the line B-B, i.e. along the movement axis D of the moveable cylinder 42. Fig. 7a shows the hollow cylinder 42 in its initial position with the variable volume 34a having a minimum size. A spring element 62 is arranged between the stationary piston 44 and the hollow cylinder 42 and provides that the cylinder 42 is kept in or returns to its initial position when liquid pressure in the variable volume 34a generates a deflection force that is smaller than a restoring force of the spring element 62.

[0042] The stationary piston 44 is hollow and has an inlet 52 to the variable volume 34a between the hollow element 42 and the piston 44. A piston gasket 64 is provided at the free end of the piston 44 to provide a movable or slidable and leak-proof connection between the piston 44 and the cylinder 42 or volume 34a. The piston 44 is connected to the feed pipe 48 to supply liquid, i.e. con-

densate, to the variable volume 34a. The cross section of the inlet 52 to the variable volume 34a is larger than the cross section of the outlet 54 out of the variable volume 34a. Thus when liquid is supplied to the variable volume 34a via the feed pipe 48 and the drain pump 36 or circulation pump 37, liquid pressure builds-up in the variable volume 34a such that the moveable cylinder 42 is pushed along the axis D as shown in Figs. 7b-c. While the cylinder 42 is pushed along the axis D liquid is ejected via the outlet 54 in a liquid spray, i.e. the liquid spray moves along the heat exchanger 10.

[0043] When the cylinder 42 reaches an end position or maximum deflected position as depicted in Fig. 7c, the variable volume 34c has a maximum size. In the end position the liquid spray has at least covered or moved along the complete width of the heat exchanger 10 in direction of axis D. When the end position is reached the control unit is adapted to switch off the corresponding pump 36, 37 or is adapted to reduce the pumping speed or flow rate thereof, such that the liquid supply to the hollow cylinder 42 is stopped or reduced. The residual liquid pressure in the hollow element 42 or variable volume 34c is gradually released via the nozzle outlet 54 while the restoring force of the spring element 62 moves the cylinder 42 back to its initial position as shown in Fig. 7a. The above described movement from the initial position (Fig. 7a) to the end position (Fig. 7c) and back to the initial position is executed at least once during a cleaning phase for the heat exchanger, preferably several times.

[0044] Fig. 8 shows a sectional side view of a cleaning device 41' according to a second embodiment in the plane of the movement axis D of the cleaning device 41. Fig. 9 shows a sectional side view of the cleaning device 41' of Fig. 8 in a plane perpendicular to the movement axis D. Unless otherwise mentioned elements as well as operation modes of the cleaning device 41' of the second embodiment correspond to the elements and operation modes of the cleaning device 41 of the above described embodiment. Like reference numerals are used for like elements.

[0045] In contrast to the above described embodiment, a variable volume 34' between a hollow cylinder 42' and a stationary piston 44' of the cleaning device 41' of Fig. 8 is supplied with liquid through an inlet 52' or lug provided at the hollow cylinder 42'. The inlet 52' or lug is located at a free end portion of the hollow element 42' where also the nozzle outlet 54 is arranged. I.e. in contrast to the above described embodiment the stationary piston 44' of the second embodiment is not used as a liquid supply line to the hollow cylinder 42'. The spring element 62 is arranged between the piston 44' and the hollow cylinder 42' as described above. To provide a pressure build-up in the variable volume as described above the cross section of the inlet 52' is larger than the cross-section of the outlet 54.

[0046] As shown in Fig. 9 condensate F is fed to the hollow element 42' via the inlet 52' at an upper portion

of the hollow element 42', wherein condensate F is ejected in a liquid spray out of the outlet 54 at a lateral or side portion of the hollow element 42'. A flexible hose (not depicted) is arranged between the inlet 52' or lug and the feed pipe 48 such that during operation of the cleaning device 41' the movement of the hollow cylinder 42' along the axis D is not restricted. The operation of the cleaning device 41' during a cleaning phase for cleaning the heat exchanger 10 corresponds to the above described operation of the cleaning device 41 according to the first embodiment.

Reference Numeral List

[0047]

2 tumble dryer
4 heat pump system
5 base section
6 refrigerant loop
8 blower
10 first heat exchanger
12 second heat exchanger
14 compressor
16 expansion device
18 drum
19 laundry
20 process air channel
20a battery channel
20b rear channel
20c rising channel
20d front channel
22 filter element
24 condensed water filter
30 condensate collector
34a-c, 34' variable chamber
36 drain pump

37 circulation pump
38 valve
5 40 condensate container
41, 41' cleaning device
42, 42' hollow cylinder
10 44, 44' stationary piston
46 drain pipe
15 48 feed pipe
50 drawer pipe
52, 52' inlet
20 54 outlet
56 front surface
25 58 upper shell
60 lower shell
62 spring element
30 64 gasket
A process air flow
35 B refrigerant flow
D movement axis
F condensate flow
40

Claims

1. Laundry treatment apparatus, in particular dryer or washing machine having a dryer function, comprising
a control unit,
a laundry treatment chamber (18) for treating laundry (19) using process air,
50 a process air loop (20, 20a-d) for circulating the process air,
a heat exchanger (10) arranged in the process air loop for cooling the process air,
a hollow element (42, 42') comprising at least one outlet opening (54), wherein the hollow element (42, 42') is in fluid communication with a liquid supply source and adapted to spray liquid to the heat exchanger (10) by at least one liquid spray from the at

least one outlet opening (54) for cleaning the heat exchanger, and
 an actuator for actuating the hollow element (42, 42') along a cleaning axis (D) such that the heat exchanger (10) is cleaned by at least one liquid spray moving along the heat exchanger (10),

characterized in that

the hollow element (42, 42') and the actuator are movably coupled so as to define therebetween a variable volume (34a-c) fluidly connected to the liquid supply source.

2. Laundry treatment apparatus according to claim 1, wherein the size of the variable volume (34a-c) depends on the liquid flowing through the volume (34a-c).
3. Laundry treatment apparatus according to claim 1 or 2, wherein the volume (34a-c) is varied in dependency of the liquid pressure or flow rate.
4. Laundry treatment apparatus according to claim 1, 2 or 3, wherein the arrangement of the hollow element (42, 42') and the actuator is configured such that the hollow element (42, 42') moves along the cleaning axis (D) in dependency of the liquid pressure in or the flow rate through the hollow element (42, 42') or the variable volume (34a-c).
5. Laundry treatment apparatus according to any of claims 1 to 4, wherein the actuator is at least partially operated hydraulically or is operated hydraulically unidirectional, and wherein the hollow element (42, 42') is a cylinder portion of the actuator and the actuator further comprises a stationary piston (44, 44'), or wherein the hollow element (42, 42') is a piston portion of the actuator and the actuator comprises a stationary cylinder portion.
6. Laundry treatment apparatus according to any of claims 1 to 5, wherein the actuator comprises a stationary hollow piston (44) in fluid communication with the hollow element (42) and fluidly connected to the liquid supply source such that the hollow element (42) is supplied with liquid via the hollow piston (44).
7. Laundry treatment apparatus according to claim 6, wherein an outlet cross section of the hollow piston (44) is larger than the cross section of the at least one outlet opening (54).
8. Laundry treatment apparatus according to any of claims 1 to 5, wherein the actuator comprises a stationary piston (44, 44') at least partially arranged in the hollow element (42, 42').

9. Laundry treatment apparatus according to claim 8, wherein the hollow element (42') comprises an inlet opening (52') or a lug configured to be connected to the liquid supply source.
10. Laundry treatment apparatus according to claim 9, wherein the cross section of the inlet opening (52') is larger than the cross section of the at least one outlet opening (54).
11. Laundry treatment apparatus according to claim 9 or 10, wherein a flexible conduit is arranged between the inlet opening (52') and the liquid supply source such that the flexible conduit is configured to move with the hollow element (42') along the axis (D).
12. Laundry treatment apparatus according to any of the previous claims, comprising an elastic element (62) configured to provide a restoring force such that an initial or rest position of the hollow element (42, 42') is restored after a deflection of the hollow element (42, 42') along the cleaning axis (D).
13. Laundry treatment apparatus according to claim 12, wherein the elastic element (62) is part of the actuator and wherein the elastic element (62) is arranged between a or the piston (44, 44') and the hollow element (42, 42').
14. Laundry treatment apparatus according to any of the previous claims, wherein the supply source comprises a supply pump (36, 37) or a valve, wherein the pump (36, 37) is switched on or a valve is opened to start a cleaning movement along the axis (D), and wherein the pump (36, 37) is switched off or the valve is closed to return the hollow element (42, 42') to an initial position.
15. Laundry treatment apparatus according to any of the previous claims, comprising a condensate collector (30) for collecting condensate generated by the heat exchanger (10), wherein the hollow element (42, 42') is connected to the condensate collector (30).
16. Laundry treatment apparatus according to any of the previous claims, wherein a basement (5) comprises an upper shell (58) and a lower shell (60) to form a portion of the drying circuit where the heat exchanger (10) is arranged.
17. Laundry treatment apparatus according to claim 16, wherein the upper shell (58) comprises a housing for the hollow element (42, 42') and the actuator.
18. Laundry treatment apparatus according to claim 16 or 17, wherein the lower shell (60) forms the con-

densate collector (30) where a supply pump (36, 37) for the hollow element (42, 42') is arranged.

19. Laundry treatment apparatus according to any of the previous claims, wherein a heat pump system is provided, which includes a compressor (14), a first heat exchanger (10), expansion means (16) and a second heat exchanger (12), the first heat exchanger (10) is adapted to cool down the drying air and heat up the refrigerant flowing through the heat pump system, the second heat exchanger (12) is adapted to heat up the drying air and cool down the refrigerant, wherein the hollow element (42, 42') is adapted to spray liquid to at least one between the first and second heat exchanger (10, 12).

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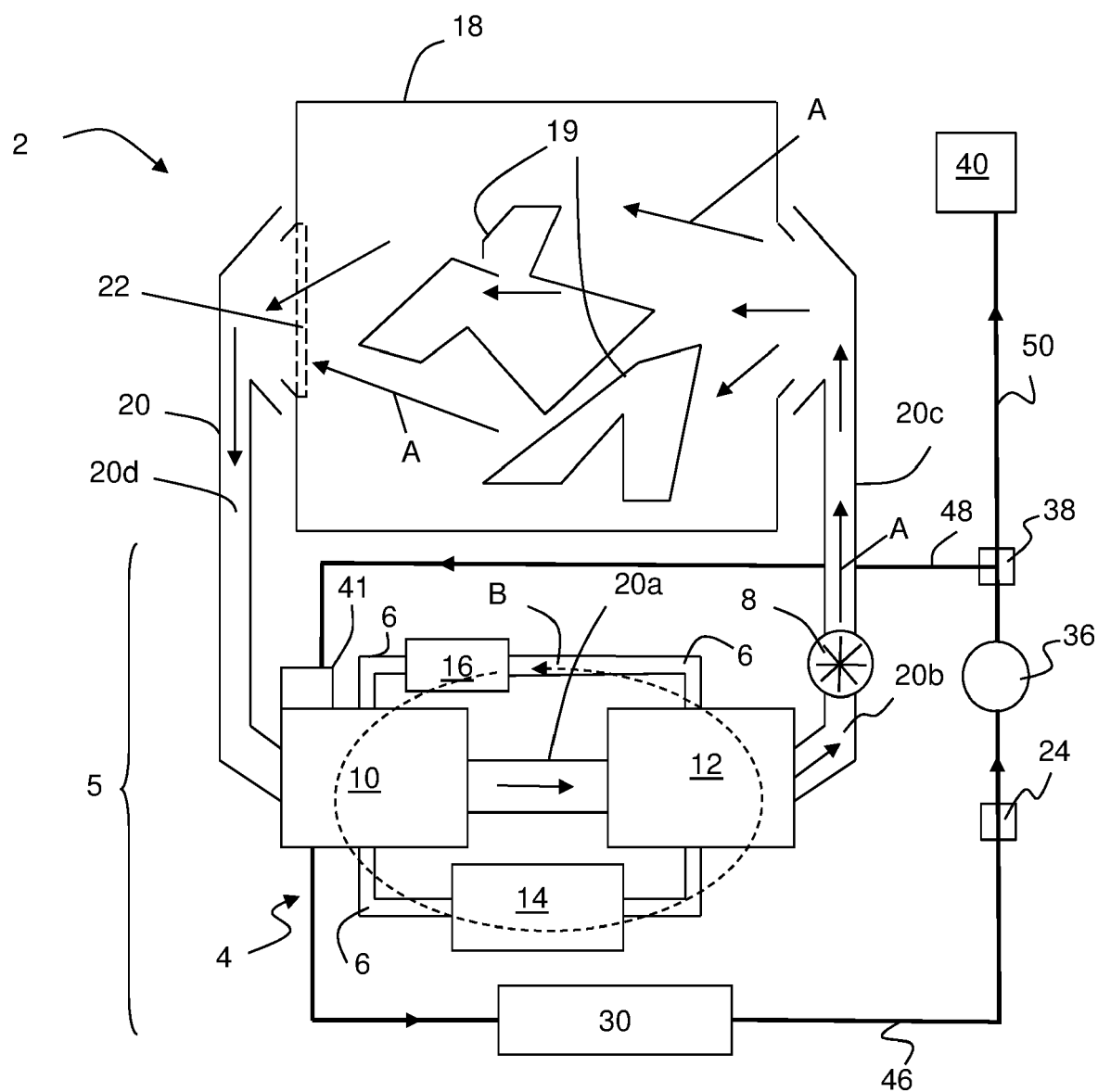
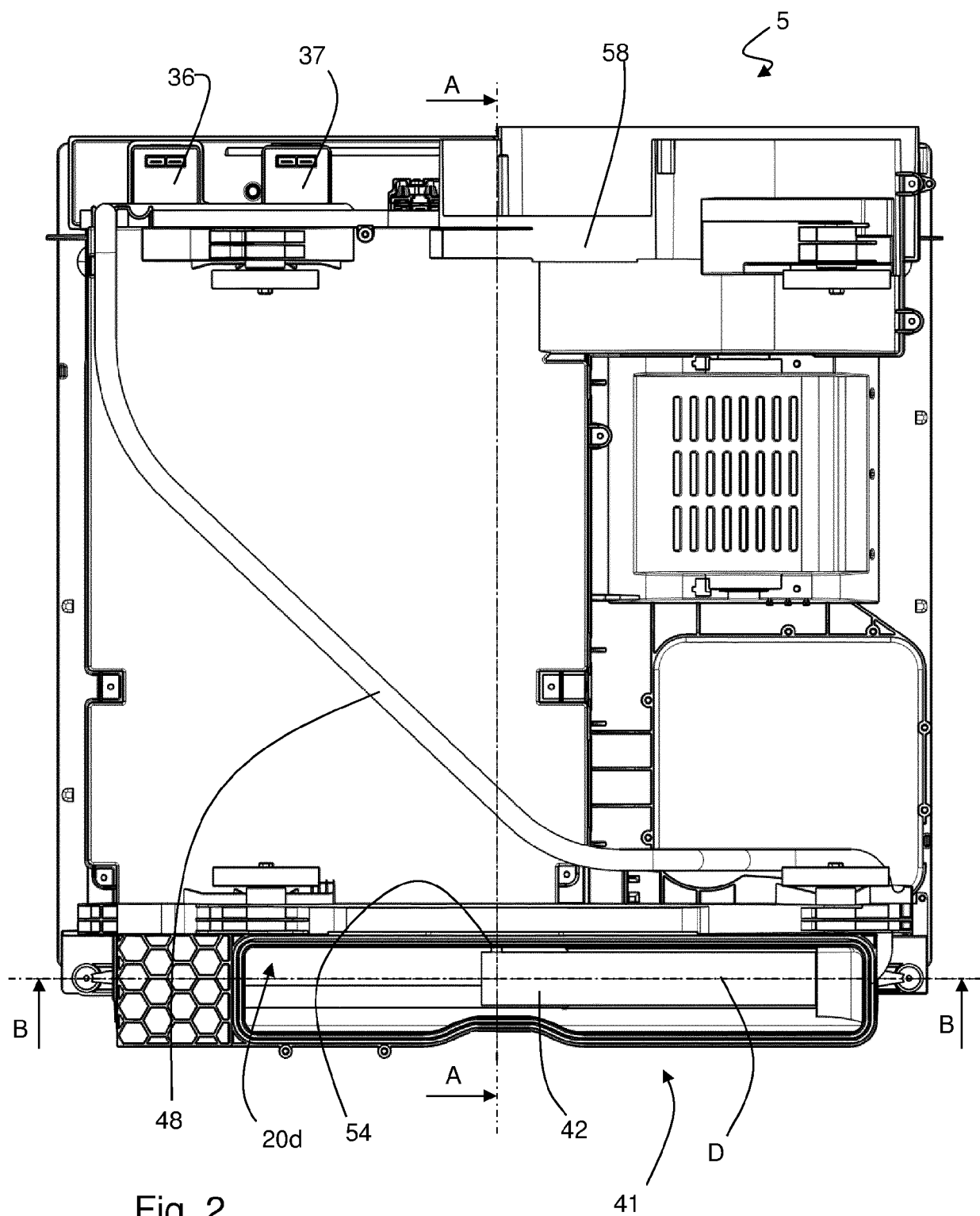
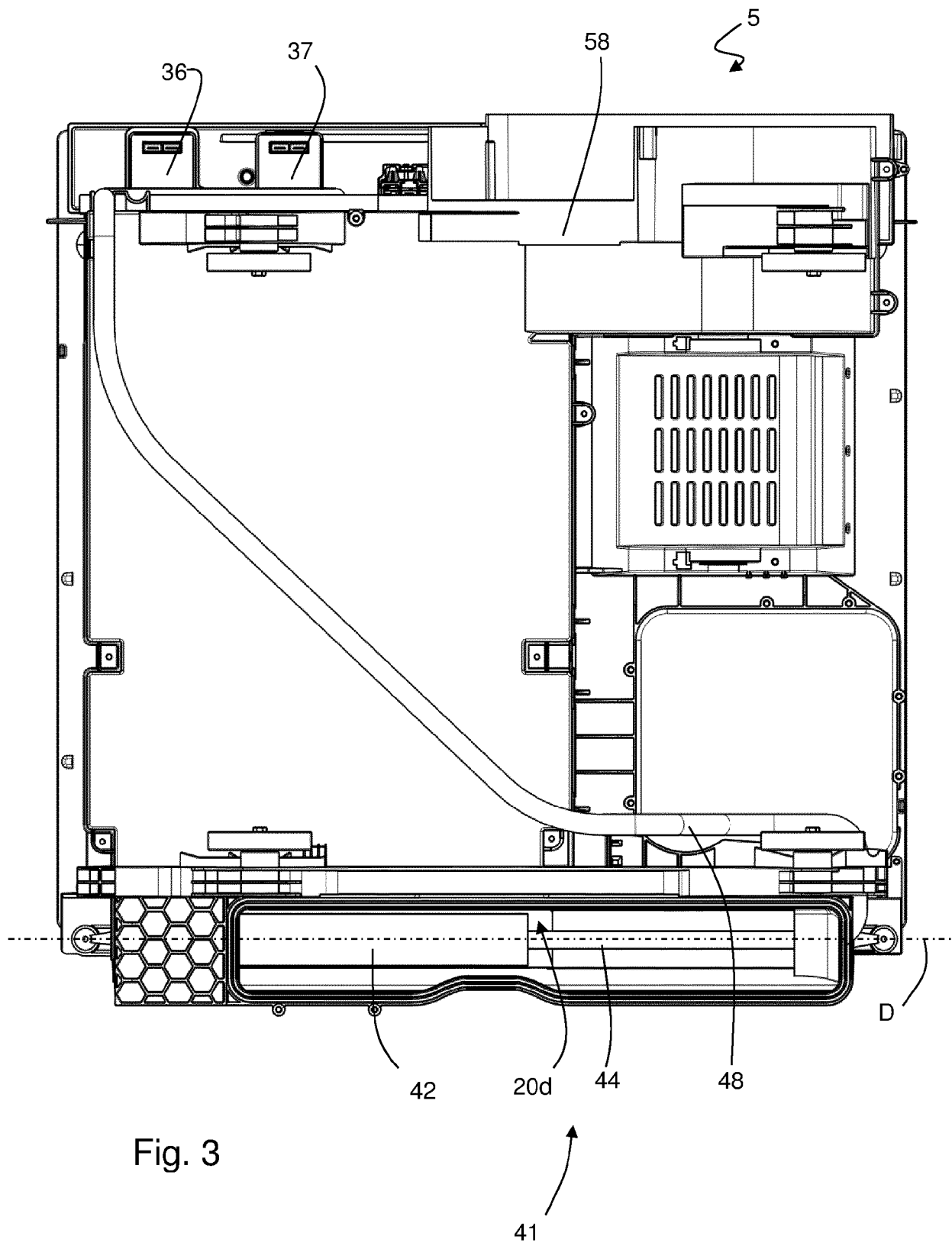


Fig. 1





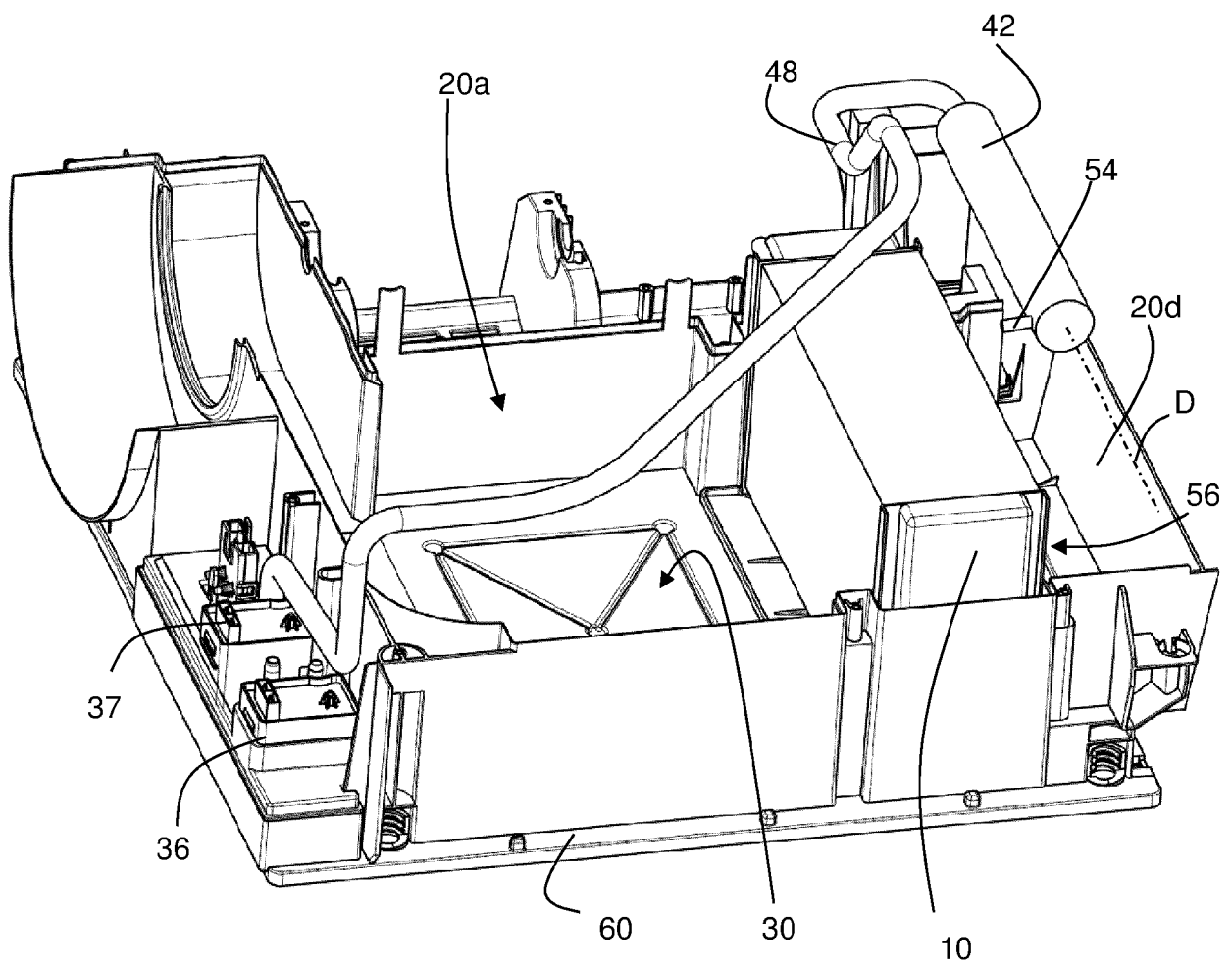


Fig. 4

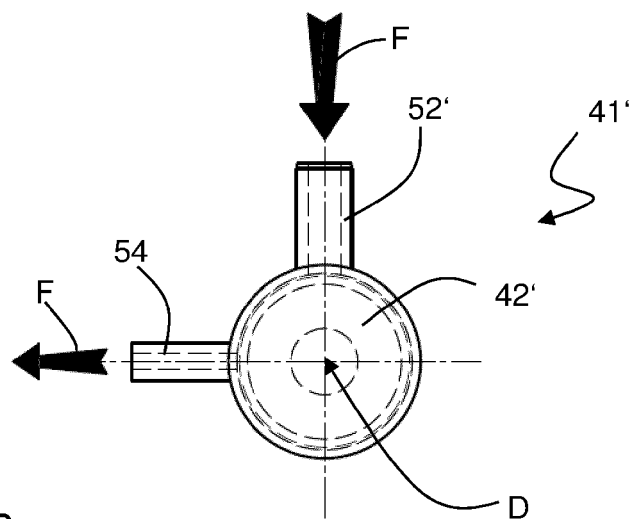


Fig. 9

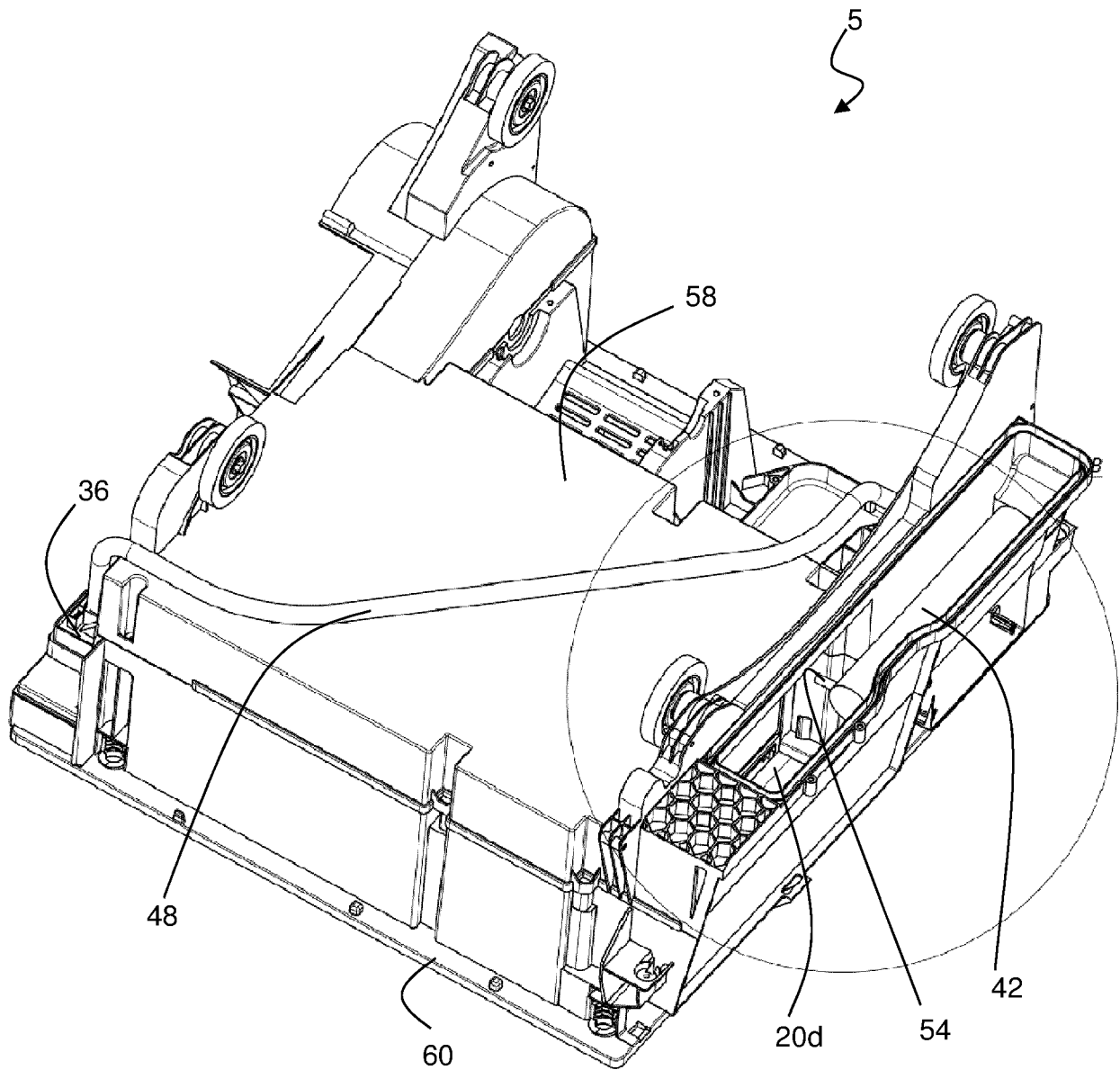


Fig. 5

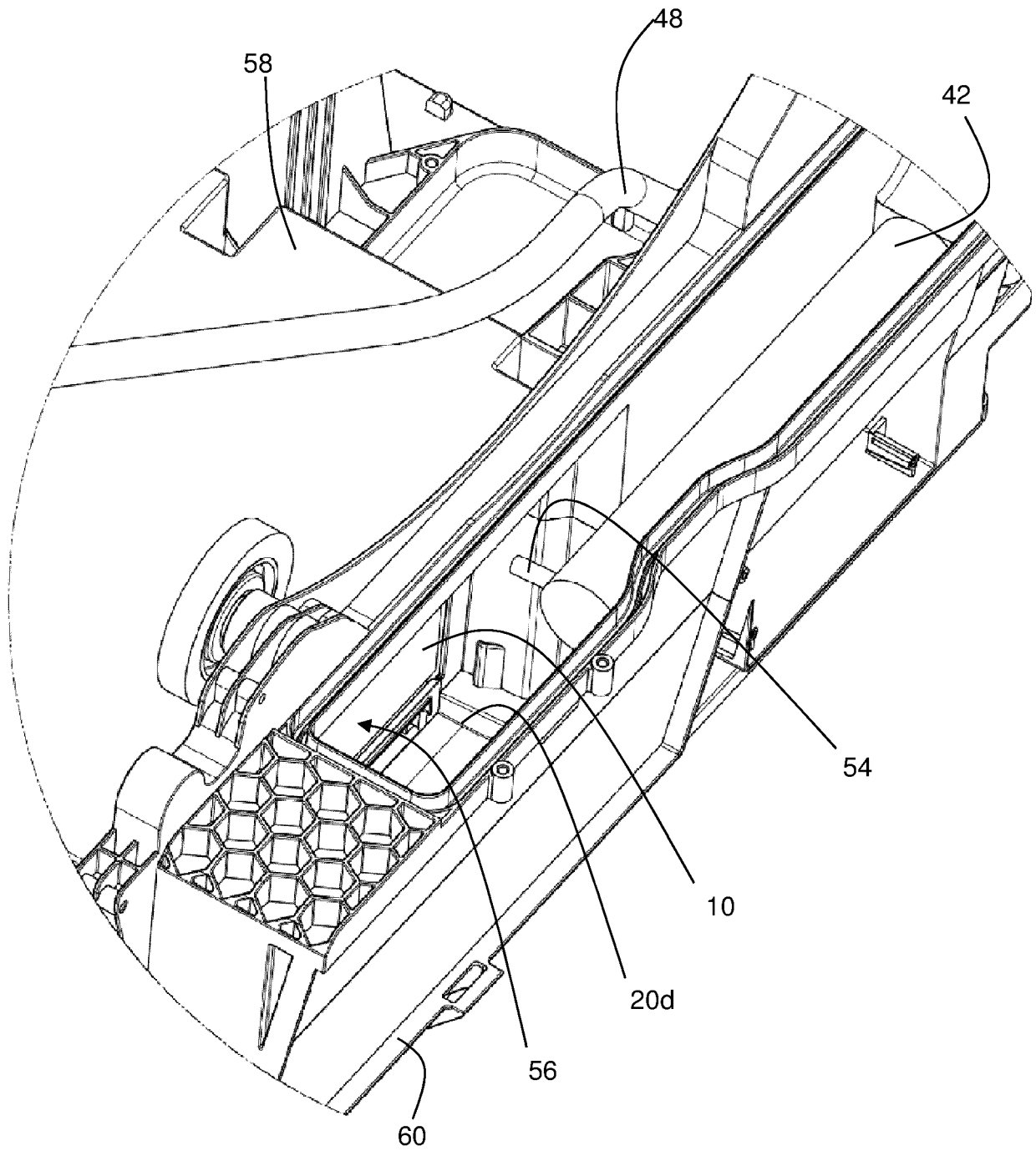


Fig. 5a

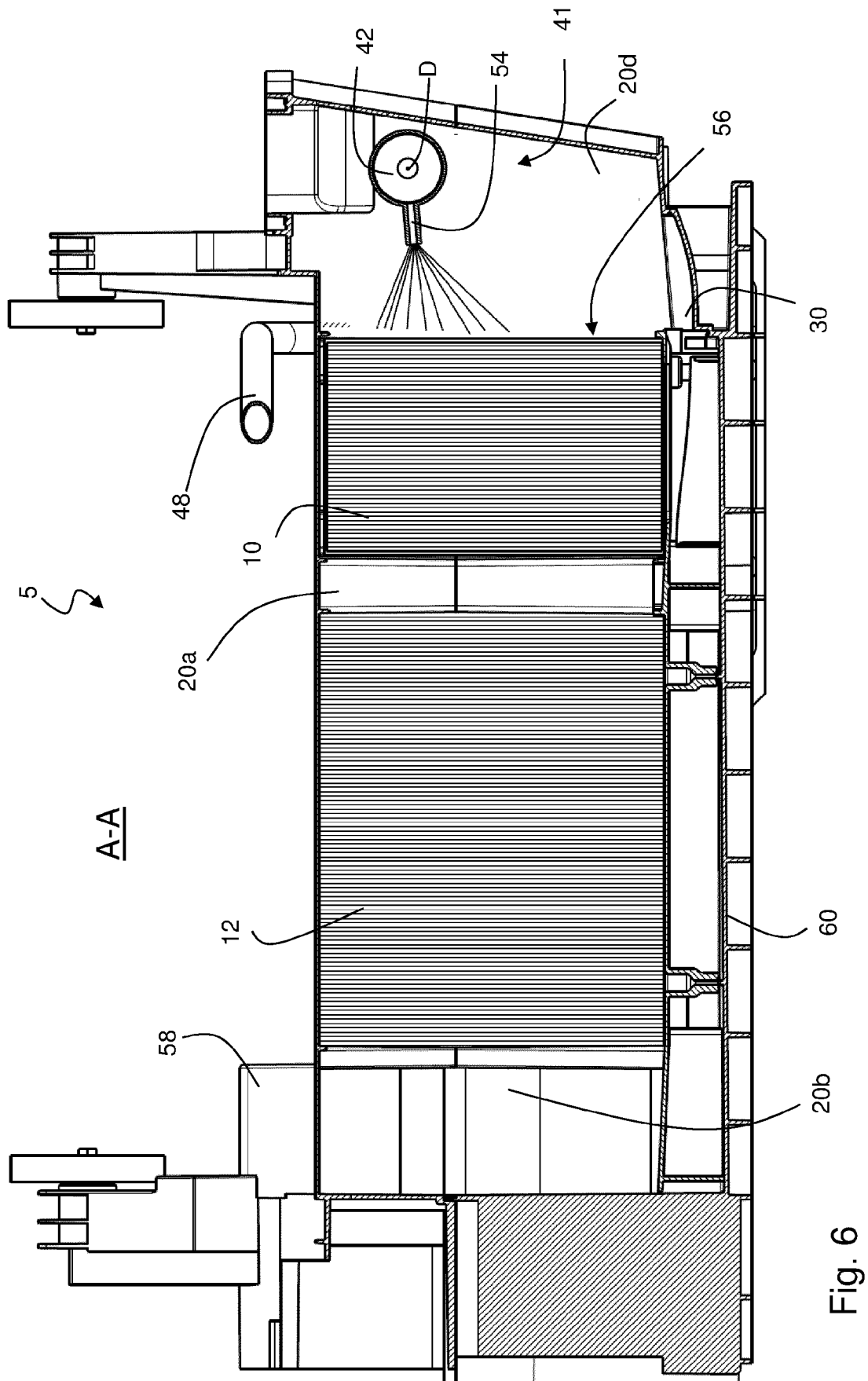


Fig. 6

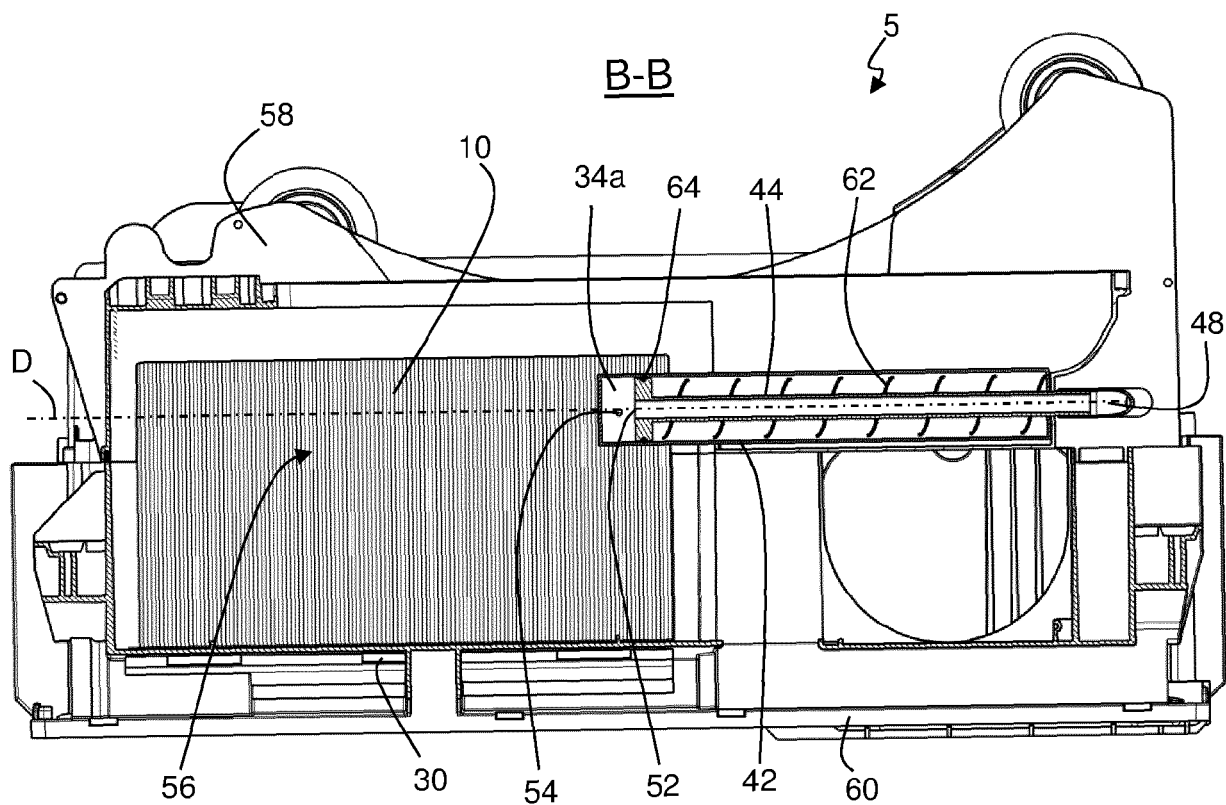


Fig. 7a

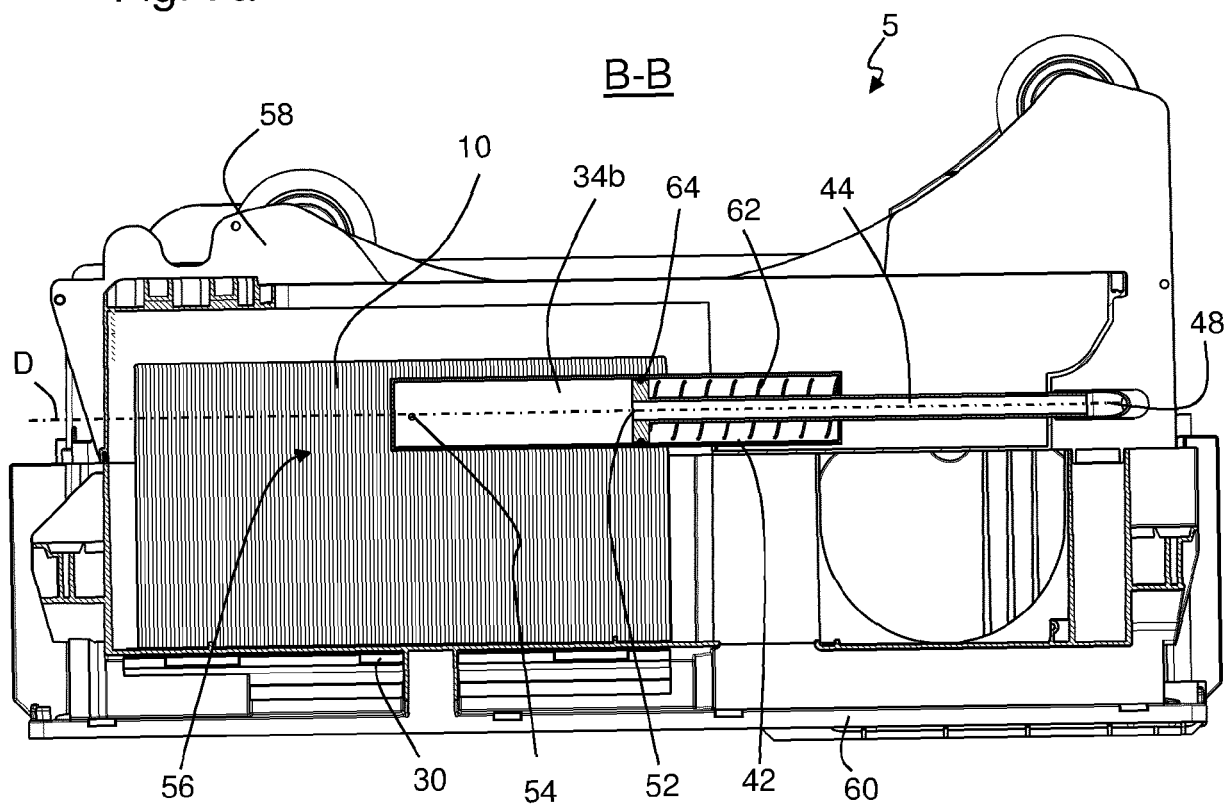


Fig. 7b

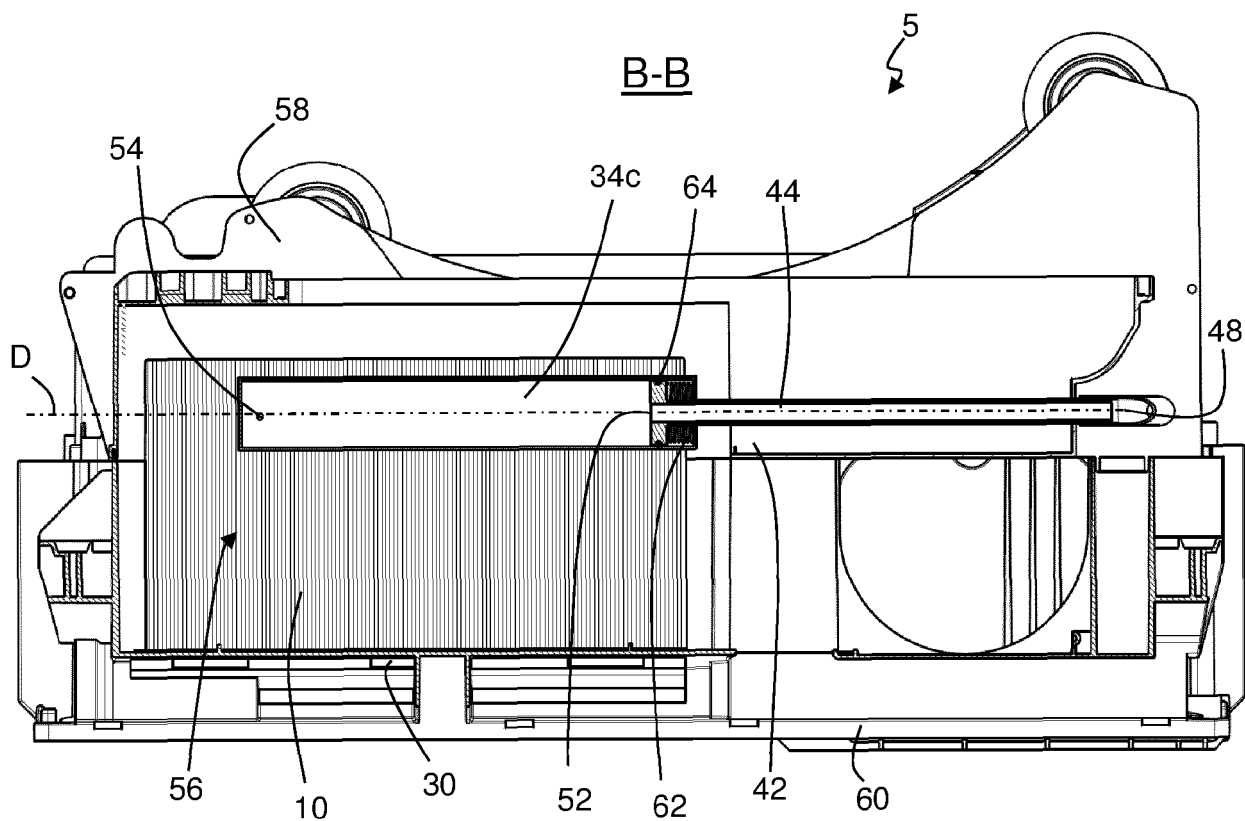


Fig. 7c

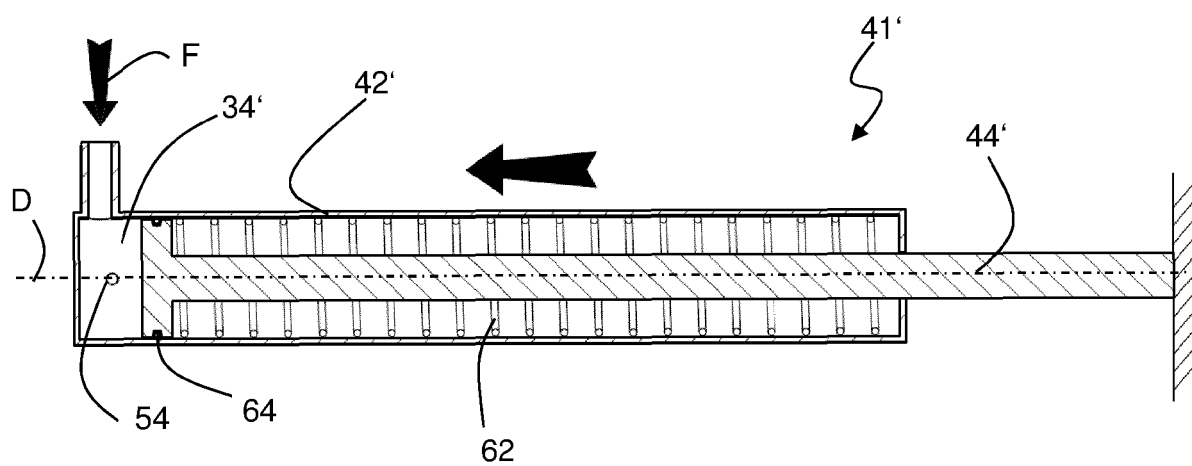


Fig. 8



EUROPEAN SEARCH REPORT

Application Number
EP 12 15 6202

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	US 2010/192398 A1 (AHN SEUNG-PHYO [KR] ET AL) 5 August 2010 (2010-08-05) * paragraphs [0009] - [0015] * * paragraphs [0049] - [0068] * * figures 1-9 *	1-19	INV. D06F58/20 D06F58/22 D06F58/24
A	WO 2011/154252 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]; BEDEWITZ RENE [DE]; KORTE MARTIN []) 15 December 2011 (2011-12-15) * page 20, line 12 - page 23, line 27 * * figures 1-4 *	1-19	
A	DE 10 2007 052835 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 7 May 2009 (2009-05-07) * paragraphs [0008] - [0010] * * claims 1-15; figures 1-9 *	1,19	
A	EP 2 365 121 A2 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 14 September 2011 (2011-09-14) * abstract; figure 1 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 July 2012	Examiner Weinberg, Ekkehard
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 15 6202

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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16-07-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010192398 A1	05-08-2010	AU 2008295744 A1	12-03-2009
		CN 101796244 A	04-08-2010
		EP 2203585 A2	07-07-2010
		US 2010192398 A1	05-08-2010
		WO 2009031812 A2	12-03-2009

WO 2011154252 A1	15-12-2011	DE 102010029892 A1	15-12-2011
		WO 2011154252 A1	15-12-2011

DE 102007052835 A1	07-05-2009	CN 101849062 A	29-09-2010
		DE 102007052835 A1	07-05-2009
		EA 201070558 A1	30-12-2010
		EP 2205787 A1	14-07-2010
		US 2010243002 A1	30-09-2010
		WO 2009059874 A1	14-05-2009

EP 2365121 A2	14-09-2011	DE 102010002663 A1	08-09-2011
		EP 2365121 A2	14-09-2011

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20100192398 A1 [0002] [0006]