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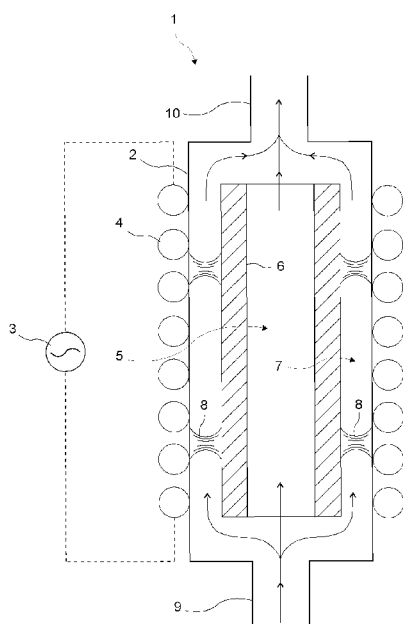
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(54) Title: A FLOW-THROUGH TYPE INDUCTION HEATER

Figure 1



(57) Abstract: Flow-through type induction heater (1) suitable for use in washers such as dishwashers (12) or washing machines (22) that have a delivery line (18) wherein hot water or steam is generated, comprising a cylindrical body (2) having an inlet orifice (9) connectable to the delivery line (18) and an outlet orifice (10), produced from a non-magnetic and thermally-insulated material, an induction coil (4) energized by a power unit (3) and a heating element (6) that generates heat using the magnetic energy applied by the induction coil (4).

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Description**A FLOW-THROUGH TYPE INDUCTION HEATER**

- [0001] The present invention relates to a flow-through type induction heater for use in washers such as dishwashers or washing machines and water heaters.
- [0002] In washers such as dishwashers and washing machines and in water heaters, hot water and/or steam generation is generally realized by resistive heaters but the resistive heaters cause a considerable amount of heat loss. It is assumed that the use of an induction heater instead of a resistive heater minimizes heat losses. For example, analyses conducted in a dishwasher show that, when a resistive heater is used, the heat loss that disperses toward the bottom part of the dishwasher is considerably more than the heat loss that disperses when an induction heater is used. Using an induction heater to provide a more efficient heating instead of a resistive heater in washers and heating installations and other water heaters where heating water is required may decrease the energy consumption which is one of the most important requirements today. Especially in washers, it is anticipated that using a flow-through type or continuous-flow type induction heater for heating the flowing water instead of the water collected in a sump would reduce the energy consumption considerably. In order for said flow-through induction heater to be suitable for use in washers and water heaters, said induction heater should be designed to occupy at most the same amount of space as the conventional resistive heater and should enable the flowing water to be heated and/or steam to be generated by means of the inductive transfer of high density energy trapped in a small volume. Unless the conditions of the heat transfer to the flowing water in the induction heater is improved, in order to reach the desired temperature level, the dimensions of the induction heater should be increased, and said induction heater becomes unusable in washers such as dishwashers and washing machines and water heaters since said induction heater occupies too much space.
- [0003] In the Patent Application No. JP2012005917, a washer such as a dishwasher and a washing machine is disclosed, wherein a flow-through

type induction heater is used.

- [0004] The aim of the present invention is the realization of a flow-through type induction heater suitable for use in washers such as dishwashers or washing machines and water heaters, wherein the heat transfer conditions are improved, the space occupied is decreased and the heating efficiency is increased.
- [0005] The induction heater realized in order to attain the aim of the present invention is a flow-through type or in other words, a continuous type induction heater and suitable for use in washers such as dishwashers or washing machines that have a delivery line enabling the hot water or steam to be delivered onto the items to be washed-sterilized, in heating installations and various water heaters.
- [0006] The induction heater of the present invention comprises a non-magnetic, thermally insulating cylindrical body that is connected to the delivery line and through which the water passes; an induction coil wound around the body, and a heating element preferably in the form of a tube with a cylindrical cross section, that is produced from a magnetic material, that has a flow channel passing through the central line thereof in the flow direction of water, that is a hollow cylinder, that is arranged concentrically in the body and that enables the water flowing through the body to be heated by generating heat with the magnetic energy generated by the induction coil.
- [0007] In an embodiment of the present invention, the outer diameter of the heating element is smaller than the inner diameter of the body, and there is a gap between the outer surface of the heating element and the inner surface of the body. In this embodiment, the water flowing through the induction heater passes both through the flow channel at the center of the heating element and the gap surrounding the heating element, and the heating element heats the water flowing therethrough and thereover.
- [0008] In another embodiment of the present invention, the inner diameter of the body and the outer diameter of the heating element are almost equal, the heating element is placed into the body without any gap therebetween, and the water passes only through the flow channel in the heating

element.

- [0009] In another embodiment of the present invention, the heating element consists of helical coils placed in the body and the flow channel is surrounded by the windings.
- [0010] In another embodiment of the present invention, the heating element is placed into the body without any gap therebetween.
- [0011] In another embodiment of the present invention, the heating element has a serrated form so as to increase the contact surface with the water that flows therethrough and/or thereover, and has protrusions extending longitudinally in the flowing direction of the water on the inner surface thereof surrounding the flow channel and/or outer surface thereof.
- [0012] The induction heater is used in washers such as dishwashers and washing machines, in heating installations in houses and work places and in water heaters for heating the washing water and/or generating steam for sterilization according to the amount of current supplied by the power unit, and thus the heating efficiency is improved and the energy is saved by providing heat transfer in a small volume.
- [0013] The induction heater realized in order to attain the aim of the present invention is illustrated in the attached figures, where:
- [0014] Figure 1 – is the schematic view of an induction heater.
- [0015] Figure 2 - is the cross-sectional view of an induction heater in a preferred embodiment of the present invention.
- [0016] view.
- [0017] Figure 3 - is the perspective view of the induction heater in Figure 2.
- [0018] Figure 4 - is the perspective view of an induction heater comprising a heating element in helical form.
- [0019] Figure 5 – is the cross-sectional view of an induction heater in an embodiment of the present invention.
- [0020] Figure 6 – is the cross-sectional view of an induction heater in another embodiment of the present invention.
- [0021] Figure 7 - is the schematic view of a dishwasher wherein the induction heater is used for heating the washing water.
- [0022] is the schematic view.

[0023] Figure 8 - is the schematic view of a dishwasher wherein the induction heater is used as a steam generator.

[0024] Figure 9 - is the schematic view of a washing machine wherein the induction heater is used for heating the washing water.

[0025] is the schematic view.

[0026] The elements illustrated in the figures are numbered as follows:

1. Induction heater
2. Body
3. Power unit
4. Induction coil
5. Flow channel
6. Heating element
7. Gap
8. Support
9. Inlet orifice
10. Outlet orifice
11. Protrusion
12. Dishwasher
13. Tub
14. Sump
15. Water softening unit
16. Circulation pump
17. Spray arm
18. Delivery line
19. Steam valve
20. Resistive heater
21. Water tank
22. Washing machine

[0027] The induction heater (1) of flow-through type or in other words, of continuous type that is suitable for use in washers such as dishwashers (12) or washing machines (22) that have a delivery line (18) wherein hot water or steam is generated, in heating installations and in various types of water heaters comprises

- [0028] - a body (2) or shell with cylindrical form, through which the water flows for heating or steam generation, having an inlet orifice (9) connected to the delivery line (18) and an outlet orifice (10), produced from a non-magnetic and thermally-insulated material such as glass or polymer and
- [0029] - an induction coil (4) that is wound around the body (2) and energized by a power unit (3).
- [0030] The induction heater (1) of the present invention comprises a heating element (6)
- [0031] - that is arranged concentrically in the body (2),
- [0032] - that is in the form of a hollow cylinder,
- [0033] - that is produced from a magnetic material, especially a ferromagnetic material such as iron,
- [0034] - that has a flow channel (5) surrounded by a cylindrical inner wall in direct contact with water and that extends longitudinally in the flowing direction of the water through the center of the heating element (6),
- [0035] - that enables the water flowing through the flow channel (5) to be heated by means of the magnetic energy generated by the induction coil (4) wound around the body (2) (Figure 1).
- [0036] The induction heater (1) is suitable for use in washers such as dishwashers (12) or washing machines (22) and enables the liquid, i.e. the washing water to be heated or the steam to be generated by the inductive transfer of the high density energy trapped in a small volume. The induction heater (1) has a form that enables the energy transferred to the water, and thus the energy to be trapped in a small volume. The induction heater (1) comprises a body (2) around which the induction coil (4) to which electric current is supplied by the power unit (3) is wound. The body (2) is produced from a non-magnetic thermally-insulated material such as silica glass or polymer. The heating element (6) heats the water that flows through the body (2) by generating heat using the magnetic energy generated by the induction coil (4). The heating element (6) used in the induction heater (1) of the present invention has the form of a hollow cylinder and is arranged in the body (2) concentrically. The thermally-insulated body (2) prevents the heat generated by the heating

element (6) from dissipating to the environment and the induction coil (4) from being overheated as well as thermal losses that may occur as a result of radiation. The heating element (6) comprises a flow channel (5) that passes through the center thereof in the flow direction of the water, and thus, the contact surface between the heating element (6) and the water is increased. Heat losses are prevented by providing a homogeneous, effective and efficient heating in the induction heater (1).

[0037] In a preferred embodiment of the present invention, the induction heater (1) comprises a heating element (6) in the form of a tube with a cylindrical cross-section (Figure 2, Figure 3).

[0038] In an embodiment of the present invention, the outer diameter of the heating element (6) is smaller than the inner diameter of the body (2), and the induction heater (1) comprises a gap (7) between the outer surface of the heating element (6) and the inner surface of the body (2). In this embodiment, the water that flows in the induction heater (1) passes through both the flow channel (5) at the center of the heating element (6) and the gap (7) between the heating element (6) and the body (2). The water contacts the cylindrical inner surface of the heating element (6) that surrounds the flow channel (5) and the cylindrical outer surface of the heating element (6) and heat is transferred to the water that flows both through and over the heating element (6) (Figure 2, Figure 3).

[0039] In this embodiment, the induction heater (1) comprises at least one support (8) that is produced from a non-magnetic material, that extends between the outer surface of the heating element (6) and the inner surface of the body (2) and that enables the heating element (6) to be positioned concentrically in the body (2) (Figure 2, Figure 3).

[0040] In another embodiment of the present invention, the induction heater (1) comprises the heating element (6) that consists of cylindrical helical windings arranged in the body (2) and that has the flow channel (5) that passes through the center of the windings (Figure 4).

[0041] In another embodiment of the present invention, the inner diameter of the body (2) and the outer diameter of the heating element (6) are almost equal, and the heating element (6) is placed in the body (2) without any

gap therebetween. In this embodiment, the water that flows in the induction heater (1) passes only through the flow channel (5) at the center of the heating element (6) and contacts the cylindrical surface that surrounds the flow channel (5) (Figure 5).

- [0042] In another embodiment of the present invention, the heating element (6) has a serrated form so as to increase the contact surface with the water that flows therethrough and/or thereover, and comprises at least one protrusion (11) extending longitudinally in the flowing direction of the water on the inner surface thereof surrounding the flow channel (5) and/or the outer surface thereof (Figure 6).
- [0043] The induction heater (1) of the present invention is used in washers such as dishwashers (12) or washing machines (22) for heating the washing water based on the current supplied by the power unit (3) and/or for generating steam for sterilization purposes (Figure 7, Figure 8, Figure 9).
- [0044] In an embodiment of the present invention, the dishwasher (12) comprises a tub (13) wherein dishes are washed, a sump (14) wherein the washing water is collected, a water softening unit (15) for decreasing the hardness of the water taken from the water mains, a circulation pump (16) that enables the water to be circulated and a delivery line (18) that enables the water to be delivered to spray arms (17) by means of the circulation pump (16), and the induction heater (1) of the present invention is connected to the delivery line (18) so as to enable the water to be heated (Figure 7).
- [0045] In an embodiment of the present invention, the dishwasher (12) comprises a steam valve (19) that is positioned at the outlet of the water softening unit (15) and that enables the steam washing process to be performed and a delivery line (18) for sending the steam into the tub (13), and the induction heater (1) connected to the delivery line (18) is used as a steam generator. In this embodiment, preferably a conventional resistive heater (20) is connected to the second delivery line (18) that transfers the washing water to the spray arms (17) (Figure 8).
- [0046] In an embodiment of the present invention, the dishwasher (12) comprises a water tank (21) that enables the water used in the rinsing step of the washing process to be stored and used in the same program or in one of

the steps of the subsequent program and the delivery line (18) wherein the induction heater (1) is used as the steam generator is connected to the water tank (21) so as to enabling the water tank (21) to be sterilized with steam (Figure 8).

[0047] In an embodiment of the present invention, the washing machine (22) comprises a tub (13) wherein the laundry to be washed are placed, a circulation pump (16) enabling the water to be circulated, a delivery line (18) enabling the water to be delivered onto the laundry by means of the circulation pump (16), and the induction heater (1) of the present invention is connected to the delivery line (18) so as to enable the water to be heated (Figure 9).

[0048] In another embodiment of the present invention, in the washing machine (22), steam is generated for purposes such as sterilization and wrinkle removal and the induction heater (1) of the present invention is used as the steam generator.

[0049] The induction heater (1) suitable for use in washers such as dishwashers (12) and washing machines (22) for heating the washing water or generating steam can also be used in heating installations in houses and work places and in water heaters. The induction heater (1) of the present invention performs an efficient heating by improving the heat transfer conditions in a small volume, thus reducing heat losses and providing energy savings.

Claims

1. An induction heater (1) of flow-through type that is suitable for use in washers such as dishwashers (12) or washing machines (22) that have a delivery line (18) wherein hot water or steam is generated, in heating installations and in various types of water heaters **comprising**
 - a body (2) with cylindrical form, through which the water flows for heating or steam generation, having an inlet orifice (9) connected to the delivery line (18) and an outlet orifice (10), produced from a non-magnetic and thermally-insulated material and
 - an induction coil (4) that is wound around the body (2) and energized by a power unit (3),
characterized by a heating element (6)
 - that is arranged concentrically in the body (2),
 - that is in the form of a hollow cylinder,
 - that is produced from magnetic material,
 - that has a flow channel (5) surrounded by a cylindrical inner wall in direct contact with water and that extends longitudinally in the flowing direction of the water through the center of the heating element (6),
 - that enables the water flowing through the flow channel (5) to be heated by means of the magnetic energy generated by the induction coil (4).
2. An induction heater (1) as in Claim 1, **characterized by** a heating element (6) with a cylindrical cross-section.
3. An induction heater (1) as in Claim 1 or 2, **characterized by** the gap (7) between the outer surface of the heating element (6) and the inner surface of the body (2), wherein the outer diameter of the heating element (6) is smaller than the inner diameter of the body (2).
4. An induction heater (1) as in Claim 3, **characterized by** at least one support (8) that is produced from a non-magnetic material, that extends between the outer surface of the heating element (6) and the inner surface of the body (2) and that enables the heating element (6) to be positioned concentrically in the body (2).
5. An induction heater (1) as in Claim 1 or 2, **characterized by** the heating element (6) that consists of cylindrical helical windings arranged in the body (2)

and that has the flow channel (5) that passes through the center of the windings.

6. An induction heater (1) as in Claim 1 or 2, **characterized by** the heating element (6) that is arranged in the body (2) without any gap therebetween, wherein the inner diameter of the body (2) and the outer diameter of the heating element (6) are almost equal.
7. An induction heater (1) as in Claim 3 or 6, **characterized by** the heating element (6) comprising at least one protrusion (11) extending on the inner surface thereof surrounding the flow channel (5) and/or on the outer surface thereof, longitudinally along the flowing direction of the water.
8. A dishwasher (12) **characterized by** an induction heater (1) as in any one of the above claims that is used for heating the washing water and/or for generating steam according to the current supplied by the power unit (3).
9. A dishwasher (12) as in Claim 8, comprising a tub (13), a sump (14) wherein the washing water is collected, a water softening unit (15), a circulation pump (16) and a delivery line (18) that enables the water to be delivered to spray arms (17) by means of the circulation pump (16), **characterized by** the induction heater (1) that is connected to the delivery line (18) so as to enable the washing water to be heated.
10. A dishwasher (12) as in Claim 8, comprising a steam valve (19) that is positioned at the outlet of the water softening unit (15) and that enables the steam washing process to be performed, and a delivery line (18) for sending the steam into the tub (13), **characterized by** the induction heater (1) that is connected to the delivery line (18) so as to be used as a steam generator.
11. A dishwasher (12) as in Claim (8), comprising a water tank (21) that enables the water that is used in the rinsing step of the washing process to be stored and used in the same program or in one of the steps of the subsequent program and a delivery line (18) that enables the steam to be delivered to the water tank (21), **characterized by** the induction heater (1) that is connected to the delivery line (18) so as to be used as the steam generator.
12. A washing machine (22) **characterized by** an induction heater (1) as in any one of Claims 1 to 7 that is used for heating the washing water and/or for generating steam according to the current supplied by the power unit (3).

13. A washing machine (22) as in Claim 12, comprising a tub (13), a circulation pump (16) and a delivery line (18) that enables the water to be sent to onto the laundry by means of the circulation pump (16), **characterized by** the induction heater (1) that is connected to the delivery line (18) so as to enable the washing water to be heated.
14. A washing machine (22) as in Claim 12, **characterized by** the induction heater (1) that is used as the steam generator.

Figure 1

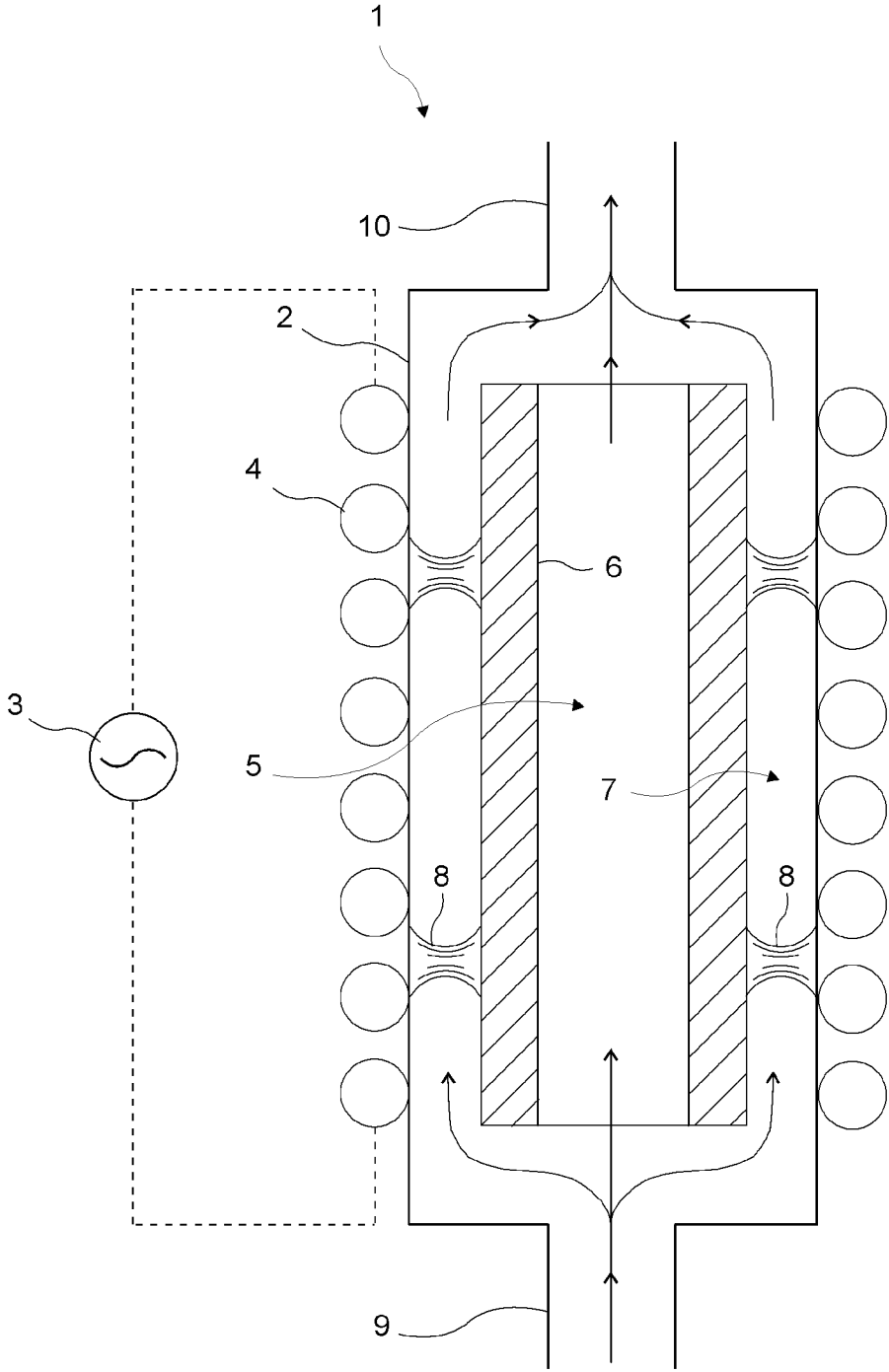


Figure 2

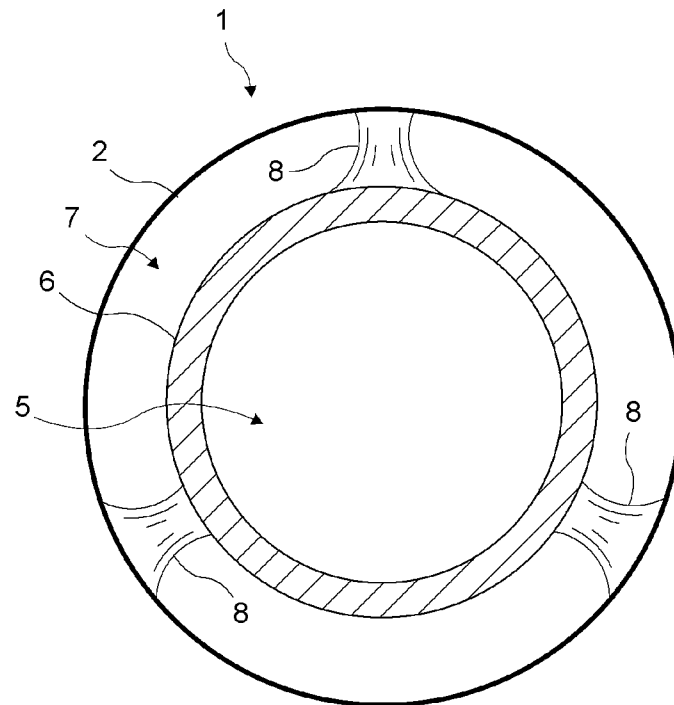


Figure 3

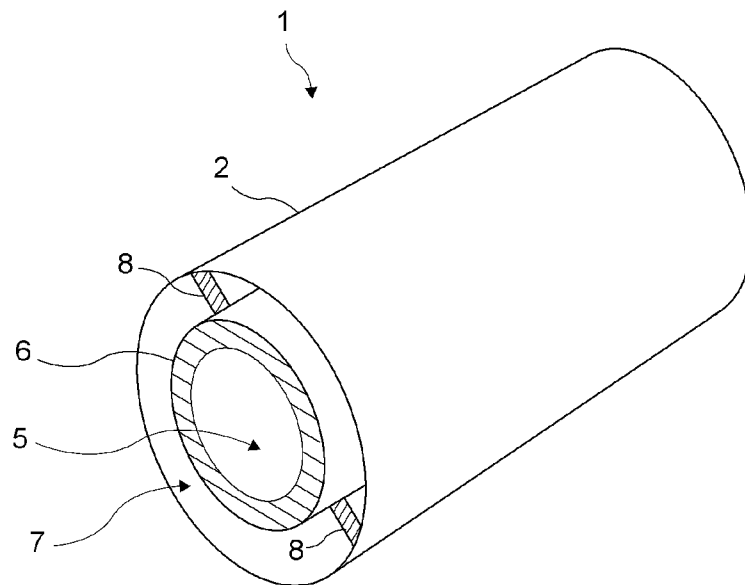


Figure 4

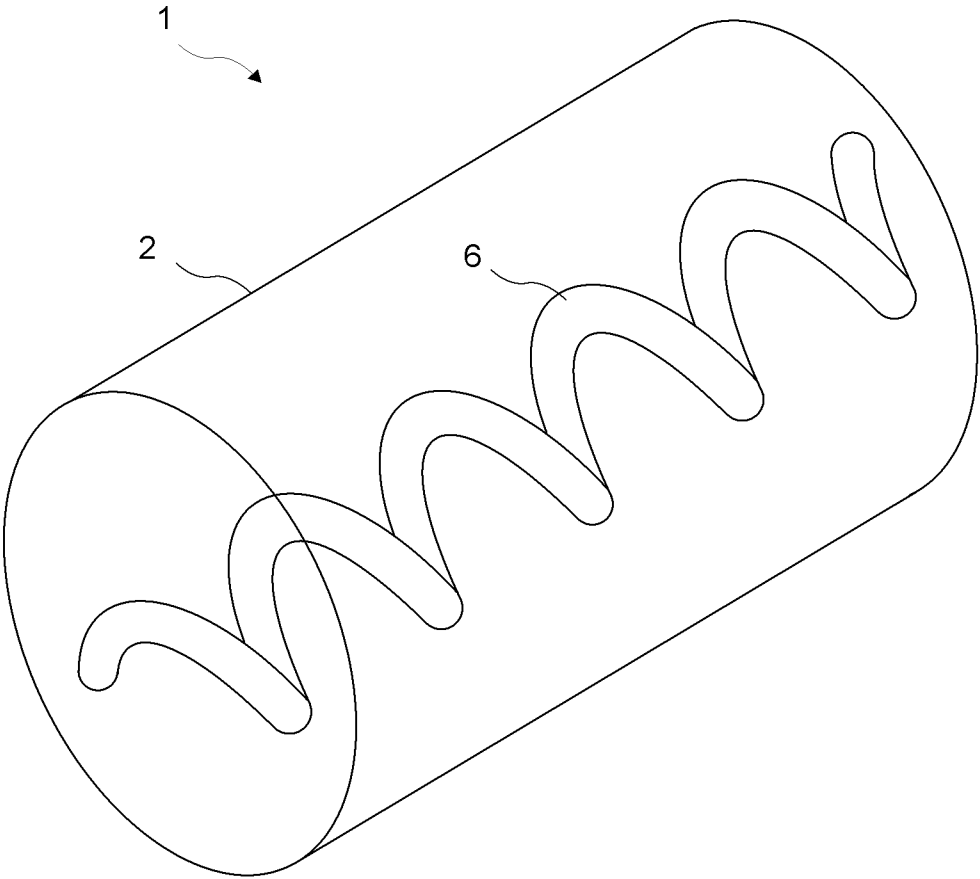


Figure 5

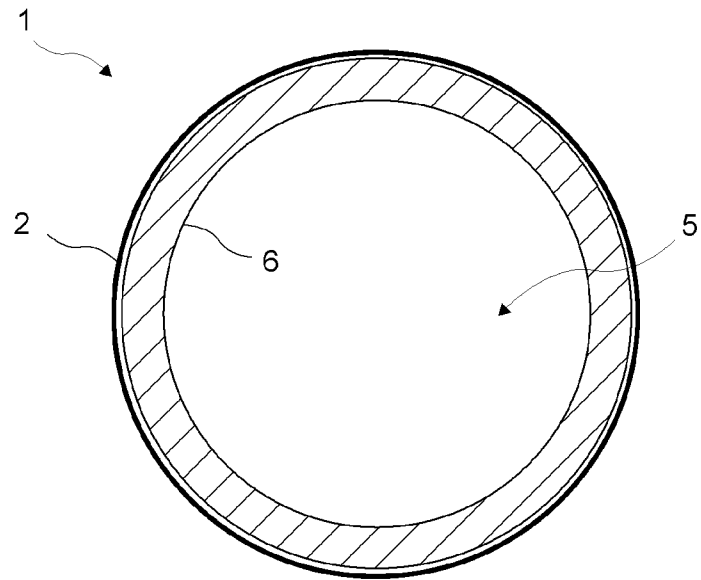


Figure 6

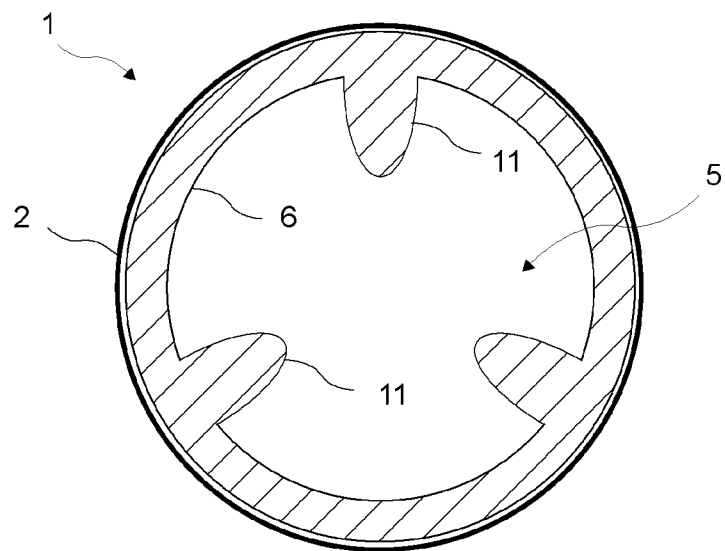


Figure 7

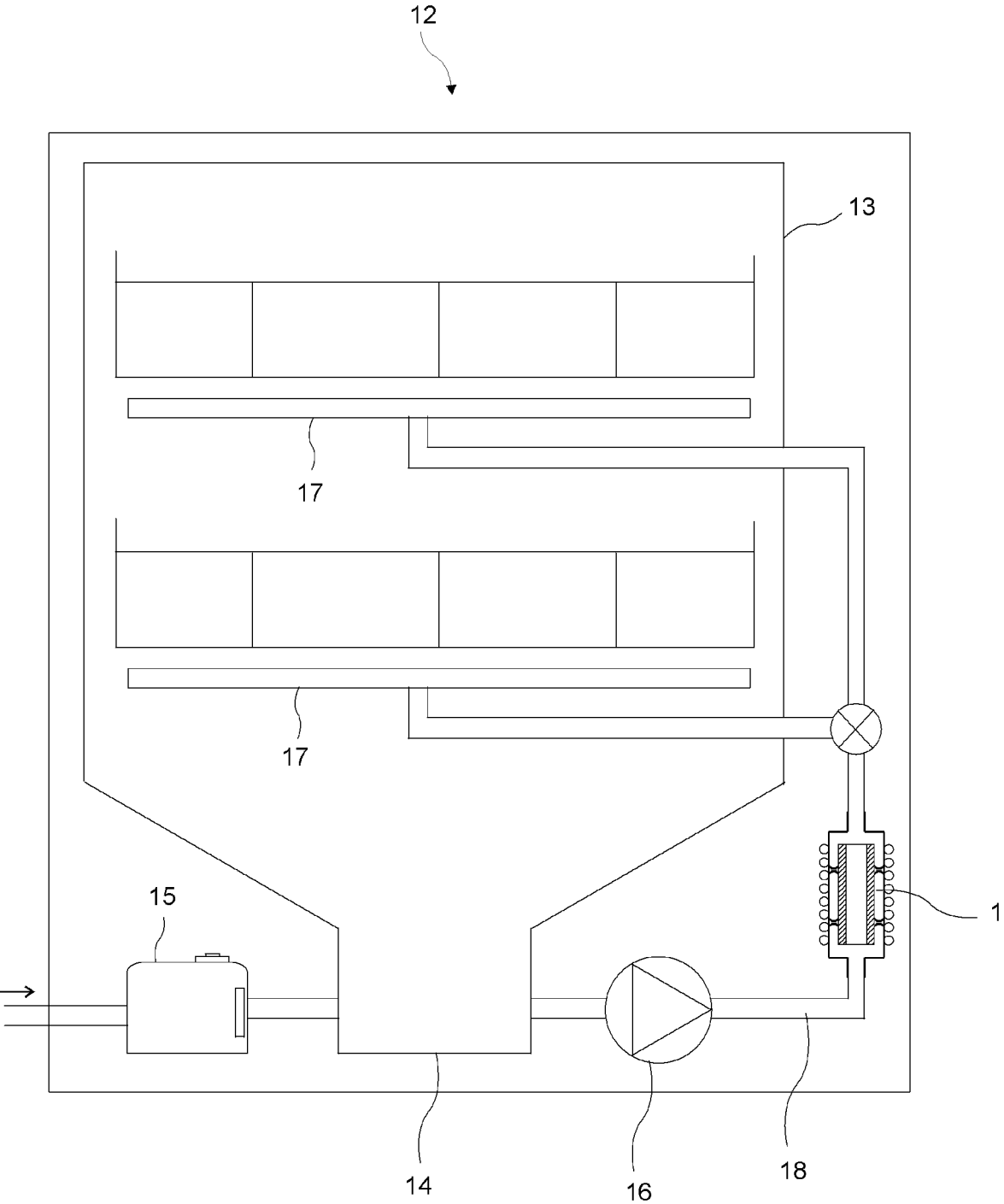


Figure 8

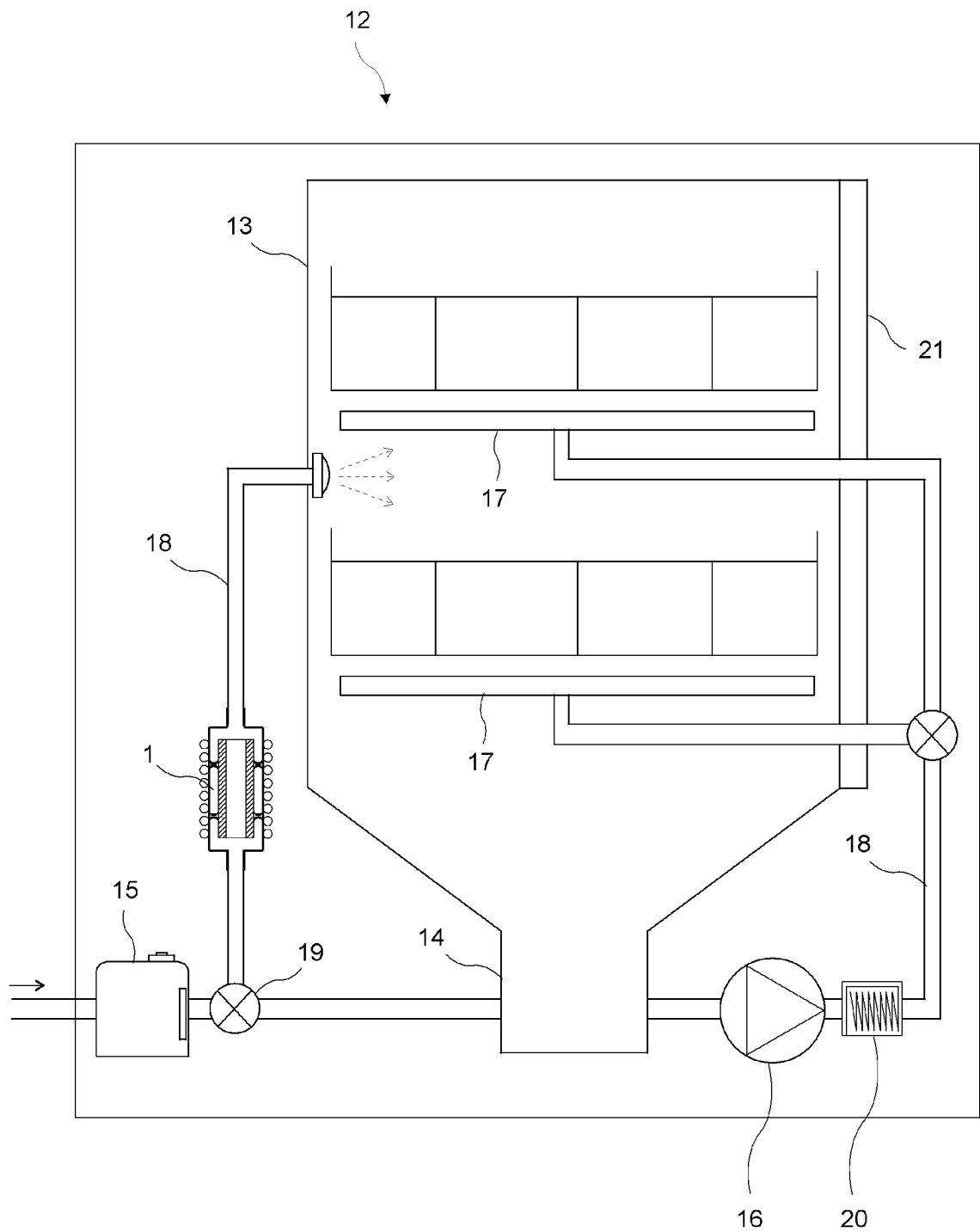
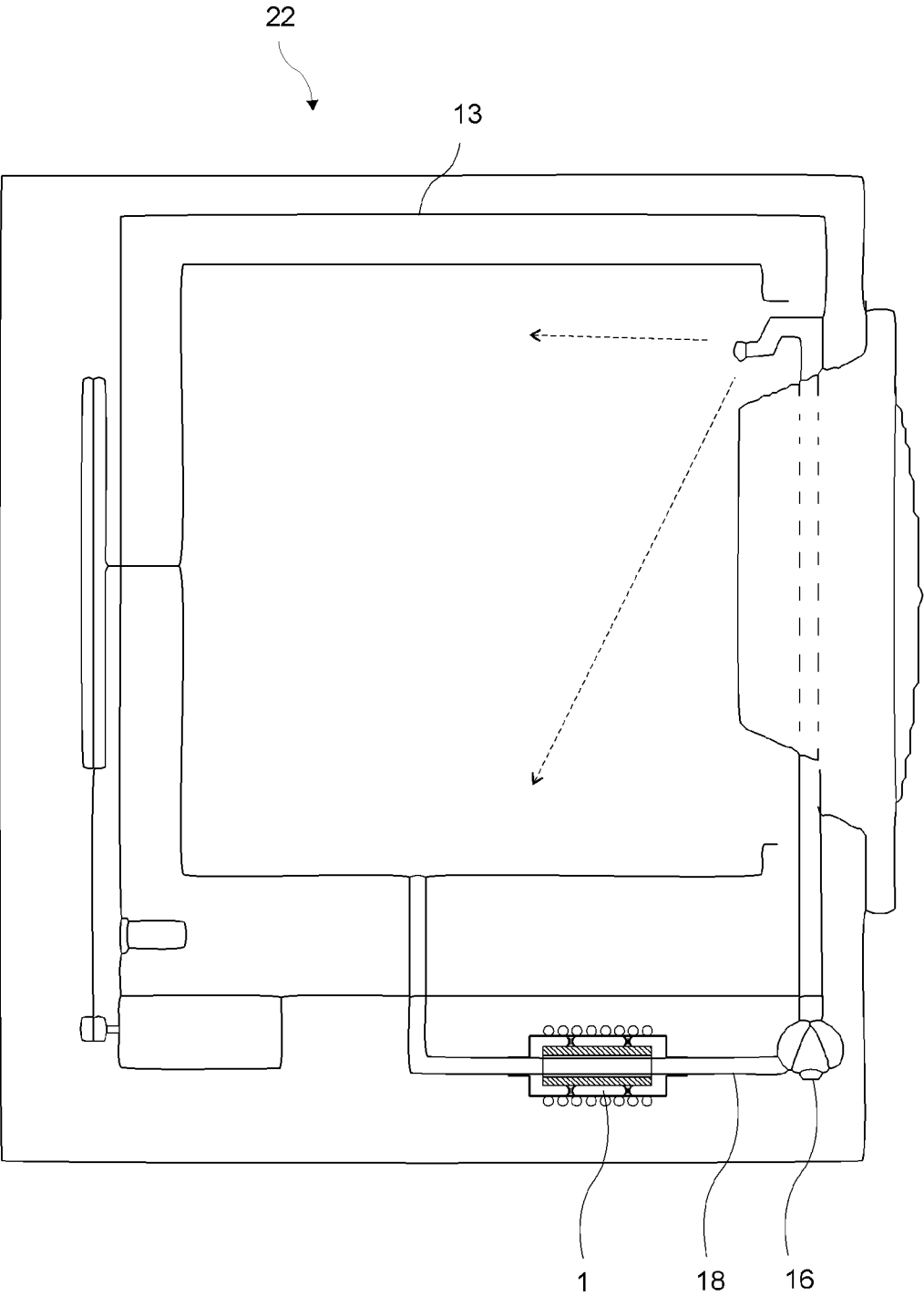


Figure 9



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. D06F39/00 A47L15/42
ADD. D06F39/04 F22B1/28

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)
D06F A47L F22B

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2005/095168 A1 (CENTANNI MICHAEL A [US] ET AL) 5 May 2005 (2005-05-05)	1-3,5,6
A	paragraphs [0002], [0010] - [0013], [0052] - [0054], [0099] - [0101], [0128] - [0136]; claims; figures 10-20	4,7-14
Y	JP 2002 181306 A (THERMO ELECTRON KK) 26 June 2002 (2002-06-26)	1-3,5,6
A	paragraphs [0007] - [0014]; claims; figures	4,7-14
A	US 6 008 482 A (TAKAHASHI YUTAKA [JP] ET AL) 28 December 1999 (1999-12-28) column 1, lines 5-14; column 6, lines 34-56; column 10, lines 20-60; column 19, lines 5-62; claims; figures 7,12,13	1-14
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Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

4 May 2018

Date of mailing of the international search report

22/05/2018

Name and mailing address of the ISA/

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Clivio, Eugenio

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/053992

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 2 400 052 A1 (VESTEL BEYAZ ESYA SANAYI VE TICARET AS [TR]) 28 December 2011 (2011-12-28) paragraphs [0002], [0009] - [0011], [0021]; claims; figures -----	1-14
A	EP 1 053 713 A2 (SMEG SPA [IT]) 22 November 2000 (2000-11-22) the whole document -----	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/053992

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