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(54) AIR CONDITIONING DEVICE

(57) The invention relates to an air conditioning device (1) for rooms with at least one air duct (2, 3) comprising an air inlet side (6, 7) and an air outlet side (8, 9), wherein a heat exchanger element (4, 5) is arranged in the air duct (2,)

According to the invention, the heat exchanger element (4, 5) is formed as a fluid line with at least one helical section (11, 12) which is arranged in an interior of the air duct (2, 3).

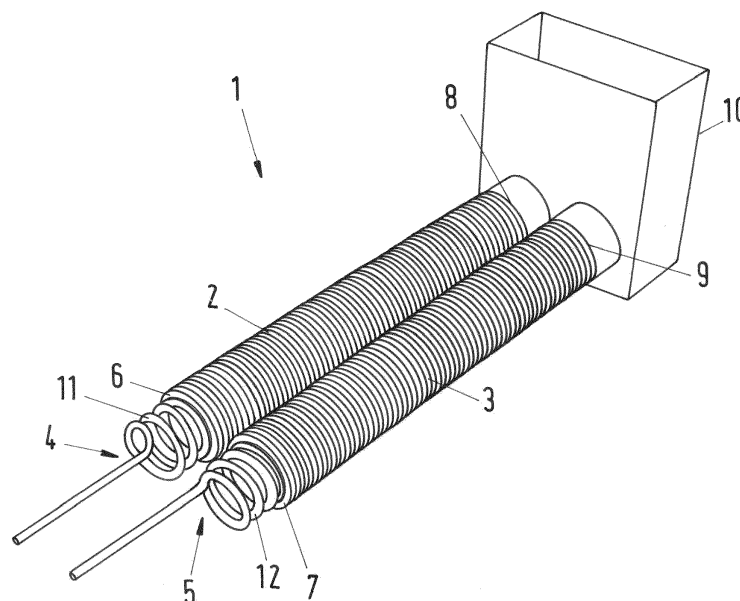


Fig.1

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Description

[0001] The invention relates to a device for air conditioning of rooms with at least one air duct comprising an air inlet side and an air outlet side, wherein a heat exchanger element is arranged in the air duct.

[0002] Such a device is used, for example, in air-conditioned buildings or for venting houses. The air supplied via one or more air ducts will be heated by means of heat exchanger element that is usually in the form of a heating element. By activating this heating element, the air flowing through the air duct is heated.

[0003] Such a device is known, for example, from US 5,640,951, where a heating wire is arranged helically between an outer wall and an inner wall of the air duct.

[0004] US 2005 017 8755 discloses an air conditioning device, which is used for heating components of a motor vehicle, such as seats. This device comprises a fan, by means of which air is supplied to a corresponding outlet through an air duct. For heating the air, an electric heating element designed as a heating wire is provided and arranged inside of the air tube.

[0005] Solutions of that kind having electric heaters require an electrical power supply and are relatively expensive, especially in respect to the associated maintenance costs. Moreover, with these solutions, only heating of air is possible, not cooling.

[0006] It is an objective of the invention to provide a device for air conditioning or venting of rooms, which has a simple structure and allows heating and cooling of the air flowing through the air duct.

[0007] This is achieved by an air conditioning device comprising the features of claim 1. Advantageous embodiments are described in the dependent claims.

[0008] In an air conditioning device for rooms with at least one air duct comprising an air inlet side and an air outlet side, wherein a heat exchanger element is arranged in the air duct, the heat exchanger element is formed as a fluid line with at least one helical section that is arranged in an interior of the air duct.

[0009] The present solution provides a cost-effective, robust and compact air conditioning device for rooms. It is easy to install, to be repaired or exchanged in already existing air ventilating systems. Due to the design of the heat exchanger element as a fluid line, liquids like the water of a water-based floor heating system or any other source and of any desired temperature can be passed through the heat exchanger element and absorb or release heat accordingly. This allows for real climate control with the possibility of both heating and cooling of the air flowing through the air duct. Accommodating the fluid line within the air ducts requires no additional external space. At the same time, the air duct protects the heat exchanger element against external influences. The helical section allows for a relatively large heat transfer surface and thus an effective heat transfer. The air conditioning device according to the invention may be used as a ventilation device wherein only a small amount of

heating or cooling energy is transferred to the air. In other words, the term air conditioning device covers ventilation devices as well.

[0010] The helical section may be formed as a circular or polygonal, in particular square-shaped helix. In particular, the shape corresponds to the inner cross section of the air duct in order to arrange the helical section on or close by the inner side of the air duct. Therewith the heat exchanger, in particular the helical section could heat or cool the inner side of the air duct.

[0011] The number of windings of the helical section may be chosen dependent on the heating or cooling demand. A higher demand corresponds to more windings and a lower demand to less windings accordingly.

[0012] Advantageously the helical section abuts on an inner side of the air duct. This has the effect that the heat exchanger element is in close contact with the inner side of the air duct and does not reduce significantly the flow cross section.

[0013] Preferably, the helical section is arranged adjacent to an incoming section of the heat exchanger element, wherein a return section is connected to the helical section by a curved section, wherein the return section extends through a space surrounded by the helical section. Since the return section extends through the helical section, it is possible to arrange ends of the heat exchanger element, which may be used for a connection to a supply and a return port, adjacent to each other. This allows a simple variable installation.

[0014] The incoming section is particularly straight and can therefore be easily manufactured in the desired length or shortened to the desired length. Thus, the heat exchanger element can be adapted to different lengths of the air duct.

[0015] It is preferred that the incoming section extends parallel to the return section at least in a portion that is encompassed by the air duct. The return section runs in particular straight and can be easily shortened to a desired length as well as the straight incoming section, whereby a simple adaptation to the installation conditions and the respective length of the air duct is achieved. Further, a contact between the incoming section and the return section and thus an unwanted temperature transition, which would degrade the effectiveness of the device, is avoided.

[0016] Preferably, the helical section abuts against the inside of the air duct under pre-tension. Such a design prevents the occurrence of vibrations between the heat exchanger element and the air duct. The pre-tension is achieved in particular by an outer diameter of the helical section being selected to be slightly larger than an inner diameter of the ventilation tube. During assembly, the helical section is pulled in the axial direction, which reduces its diameter. After insertion into the air duct, the force acting in axial direction is abandoned, so that the helix-shaped section expands in the radial direction. Thus, the helical section abuts firmly against the inside of the air duct. This way, the heat exchanger is held in

the air duct without the need of additional fastening elements.

[0017] Preferably, the heat exchanger comprises a lug. The lug can be formed as a closed eye or as an open hook and can be used to draw the heat exchanger through the air duct, for example by means of a respective tool. The lug may remain on the heat exchanger element and can be used for fixing at a later stage.

[0018] In a preferred embodiment, the lug is arranged on the curved section. This means that the lug extends the heat exchanger in a longitudinal direction. Therewith the lug can be easily achieved by a tool to draw the heat exchanger element through the air duct.

[0019] In a preferred embodiment, at least the curved section and in particular also a turn of the helical section, projects out of the air duct on the air outlet side. This allows for an easy control of position of the heat exchanger element during assembly of the air-conditioning device.

[0020] Preferably, the air duct is formed as a corrugated pipe. A corrugated pipe is very flexible and can be manufactured at relatively low cost in any desired length. Thus, a corrugated pipe is highly variable and inexpensive.

[0021] Preferably, the air duct has an outer diameter between 7 cm and 12 cm, in particular between 8 cm and 10 cm. Such an air duct comprises a relatively large free inner cross-section, which can conduct a sufficiently large air volume. Further, flow resistance is relatively low.

[0022] The device preferably comprises a plurality of air ducts, wherein said air ducts are connected to a common manifold, which in particular also supplies supply ports and return ports for the heat exchanger elements. This results in a compact design. Usually, air is blown by means of a fan and distributed by the manifold to the air ducts. In the air ducts, the temperature of the air can be influenced. In this case, air conditioning takes place via the heat exchanger elements arranged in the air ducts. The number of air ducts might be chosen depending of the size of the room which is to be ventilated or aerated by the air-conditioning device.

[0023] It is preferred that the manifold comprises a housing, on whose outer side connections are arranged for the air ducts, wherein the supply ports and return ports for the heat exchanger elements are housed in the interior of the housing. The heat exchanger elements and the corresponding connections are therefore invisible and protected by the housing. Thus, a risk of manipulation is minimized.

[0024] It is conceivable to assign thermocouple elements to the supply ports and return ports. By means of the thermocouple elements, a desired temperature of the heat exchanger element can be controlled.

[0025] Preferably, the air ducts are connected to a common air outlet. The air outlet might be integrated in particular in a floor of a room. Since several air ducts are arranged in parallel between the manifold and the air outlet, a relatively high air exchange rate can be

achieved. Thus, an effective air conditioning is possible.

[0026] The curved sections may be arranged close by the air outlet, in particular they protrude into the air outlet. This allows an easy inspection of the correct fit of the heat exchangers. Further, the air is effectively heated or cooled directly before it flows into the room.

[0027] Further features, details and advantages of the invention will become apparent from the wording of the claims and from the following description of exemplary embodiments with reference to the drawings. They show:

Fig. 1 an air-conditioning device for rooms,

Fig. 2 an air duct with a heat exchanger element installed therein and a single heat exchanger element,

Fig. 3 an air outlet with two connected air ducts and

Fig. 4 a manifold with two connected air ducts.

[0028] Fig. 1 shows an air conditioning device 1 for rooms with at least one air duct 2, 3. Inside of each air duct 2, 3 a heat exchanger element 4, 5 is arranged. The air ducts 2, 3 comprise an air inlet side 6, 7 and an air outlet side 8, 9. The air outlet sides 8, 9 of the air ducts 2, 3 are joined with an air outlet 10.

[0029] The heat exchanger elements 4, 5 are formed as fluid lines for a heat transfer fluid. The heat transfer fluid might be in particular water of a floor heating system or of a separate water system used for the air ventilation. The fluid lines have a respective helical section 11, 12, which is housed inside of the air ducts 2, 3. This helical section 11, 12 results in a large effective length and thus a high heat transfer rate.

[0030] The helical section 11, 12 is pre-stressed on an inner side of the air ducts 2, 3. Thus, the heat exchanger elements 4, 5 are safely held within the air ducts 2, 3.

[0031] It is conceivable in an arrangement as shown in Fig. 1, that the heat exchanger elements 4, 5 are arranged in series. In this case, one heat exchanger element 4 is used as an incoming path and the other heat exchanger element 5 is used as return path. However, a more flexible use results when the heat exchanger elements 4, 5 each comprises an incoming section 13, 14 and a recirculated return section 15, 16 (Figure 2).

[0032] The return section follows the helical section 11, 12 over a curved section 17, 18 and extends through a space surrounded by the helical section. Subsequently, it runs parallel to the respective return section 13, 14.

[0033] In this embodiment, incoming and return sections are arranged adjacent to each other. This enables a simple installation of the device.

[0034] A lug 19, 20 is arranged at the curved sections 17, 18 for drawing the heat exchanger elements 4, 5 in the air ducts 2, 3. Due to the drawing in and the axial force introduced, an elongation of the helical section 11, 12 results in the longitudinal direction, thereby reducing the diameter of the helical sections 11, 12. After eliminating the axial force the helical section expands radially and bias und tension to an inner side of the air ducts 2, 3.

[0035] Fig. 3 shows a view into the air outlet 10, on which the air ducts 2, 3 are joined. The heat exchanger elements 4, 5 are already installed in the air ducts 2, 3. It can be seen that the last turn of the helical section 11, 12 and the curved section 17, 18 protrude into the air outlet 10, for which sufficient space is available. In addition, the air flowing out of the air ducts 2, 3 flows even over the curved sections 17, 18 and so may possibly absorb or emit more heat. This also facilitates checking the correct installation.

[0036] Fig. 4 shows a manifold 21 having a housing 22. This housing 22 is usually closed with a lid, which is not shown for reasons of clarity.

[0037] The manifold 21 has 10 connections 23 - 32 for air ducts 2, 3, which can be led to different or even the same rooms accordingly, in order to provide conditioned air. Inside the housing 22 are supply ports and return ports 33 - 40 to which the heat exchanger elements 4, 5 can be connected. The manifold 21 thus does not only distribute the air to the air ducts 2, 3, but also the heat transfer medium, for example, the water of a floor heating system, to the heat exchanger elements 4, 5.

[0038] A thermocouple element 41 is assigned to the port 33. It is possible, to assign additional thermocouple elements to the other ports. The thermocouple element 41 is a thermos actuator that automatically varies the flow through the port depending of the temperature. In general, such thermocouple elements increases its size at higher temperatures and decreases its size at lower temperatures. This is used to actuate a valve element.

[0039] The housing 22 comprises an air supply 42. The air could be supplied by a ventilation unit of the building (not demonstrated). The manifold 21 is joint with a water supply 43 connected with the floor heating system of the building or an additional water system. The manifold will distribute this water to the heat exchanger elements. An passage of the water supply 43 is sealed by respective sealing means 44.

[0040] The invention is not limited to one of the above-described embodiments, but can be modified in many ways. For example, the air ducts might not only be formed as a corrugated pipe as shown, but also as smooth pipes. These air ducts may be composed of different sections, such as bare-tube and corrugated pipe - sections. Instead of the illustrated combined manifold, it is also conceivable to arrange the supply ports and return ports outside of the air distribution housing.

[0041] The invention enables air conditioning of room wherein heat is absorbed or released via a heat transfer fluid guided through the heat exchanger elements designed as fluid lines. The arrangement in the air ducts results in a very compact design and provides at the same time an effective heat transfer. A sufficiently long transmission path is available within the air ducts. The device is easy to install and requires no additional electrical connections and control means. Rather, it can be easily used to upgrade an existing installation.

[0042] All of the claims, the description and the draw-

ings resulting features and advantages, including design details, spatial arrangements and method steps may be essential to the invention both in itself and in a variety of combinations.

Reference numbers

[0043]

10	1	air-conditioning device
	2, 3	air ducts
	4, 5	heat exchanger elements
	6, 7	air inlet side
	8, 9	air outlet side
15	10	air outlet
	11, 12	helical sections
	13, 14	incoming sections
	15, 16	return sections
	17, 18	curved sections
20	19, 20	lug
	21	manifold
	22	housing
	23-32	air connections
	33-40	supply and return ports
25	41	thermocouple element
	42	air supply
	43	water supply
	44	sealing means

Claims

1. Air conditioning device (1) for rooms with at least one air duct (2, 3) comprising an air inlet side (6, 7) and an air outlet side (8, 9), wherein a heat exchanger element (4, 5) is arranged in the air duct (2, 3), **characterized in that** the heat exchanger element (4, 5) is formed as a fluid line with at least one helical section (11, 12), wherein the helical section is arranged in an interior of the air duct (2, 3).
2. Air conditioning device according to claim 1, **characterized in that** the helical section (11, 12) abuts on an inner side of the air duct (2, 3).
3. Air conditioning device according to claim 1 or 2, **characterized in that** the helical section (11, 12) is arranged adjacent to an incoming section (13, 14) of the heat exchanger element (4, 5), wherein a return section (15, 16) is connected to the helical section (11, 12) over a curved section (17, 18), wherein the return section (15, 16) extends through a space surrounded by the helical section (11, 12).
4. Air conditioning device according to one of the preceding claims, **characterized in that** the incoming section (13, 14) extends parallel to the return section (15, 16) at least in a portion that is encompassed by

the air duct.

5. Air conditioning device according to one of the preceding claims, **characterized in that** the helical section (11, 12) abuts against the inside of the air duct (2, 3) under pre-tension. 5
6. Air conditioning device according to one of the preceding claims, **characterized in that** the heat exchanger (4, 5) comprises a lug (19, 20) 10
7. Air conditioning device according to claim 6, **characterized in that** the lug (19, 20) is arranged on the curved section (17, 18). 15
8. Air conditioning device according to one of the preceding claims, **characterized in that** at least the curved section (17, 18), in particular also a turn of the helical section (11, 12), projects out of the air duct (2, 3) at the air outlet side (8, 9). 20
9. Air conditioning device according to one of the preceding claims, **characterized in that** the air duct (2, 3) is formed as a corrugated pipe. 25
10. Air conditioning device according to one of the preceding claims, **characterized in that** the air duct (2, 3) has an outer diameter between 7 cm and 12 cm, in particular between 8 cm and 10 cm. 30
11. Air conditioning device according to one of the preceding claims, **characterized in that** it comprises a plurality of air ducts (2, 3), wherein said air ducts (2, 3) are connected to a common manifold (21), which in particular also supplies supply ports and return ports (33-40) for the heat exchanger elements (4, 5). 35
12. Air conditioning device according to claim 9, **characterized in that** the manifold (21) comprises a housing (22), on whose outer side connections (23-32) for the air ducts (2, 3) are arranged, wherein the supply ports and return ports (33, 40) for the heat exchanger elements (4, 5) are housed in the interior of the housing 40
13. Air conditioning device according to claim 11 or 12, **characterized in that** the air ducts (2, 3) are connected to a common air outlet (10). 45
14. Air conditioning device according to claim 13, **characterized in that** the curved sections (17, 18) are arranged close by the air outlet (10), preferably they protrude into the air outlet (10). 50

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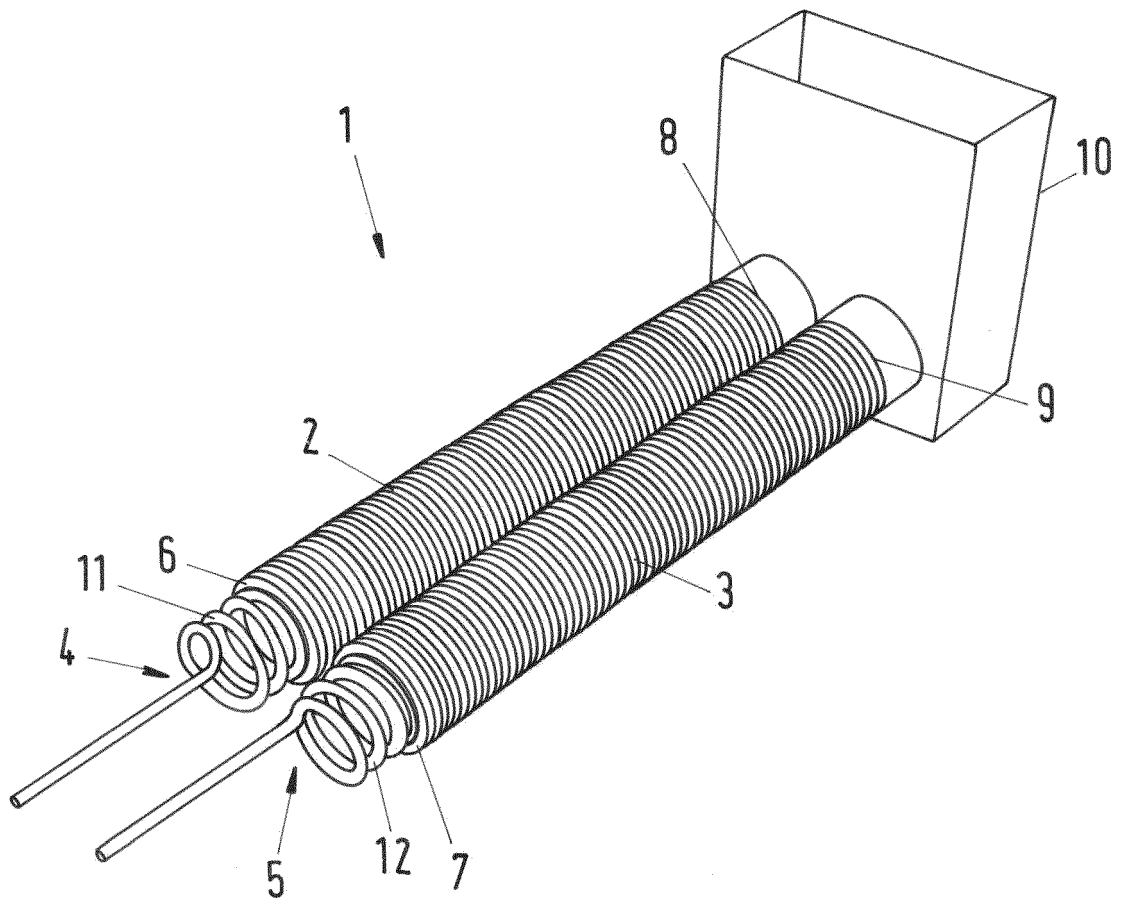


Fig.1

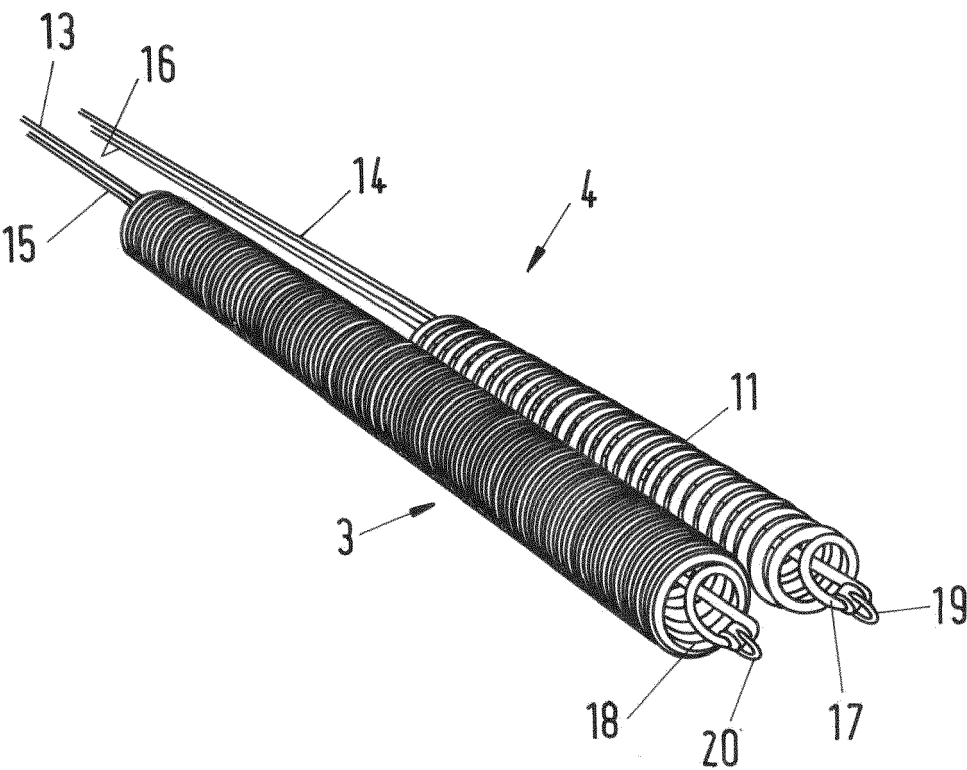


Fig.2

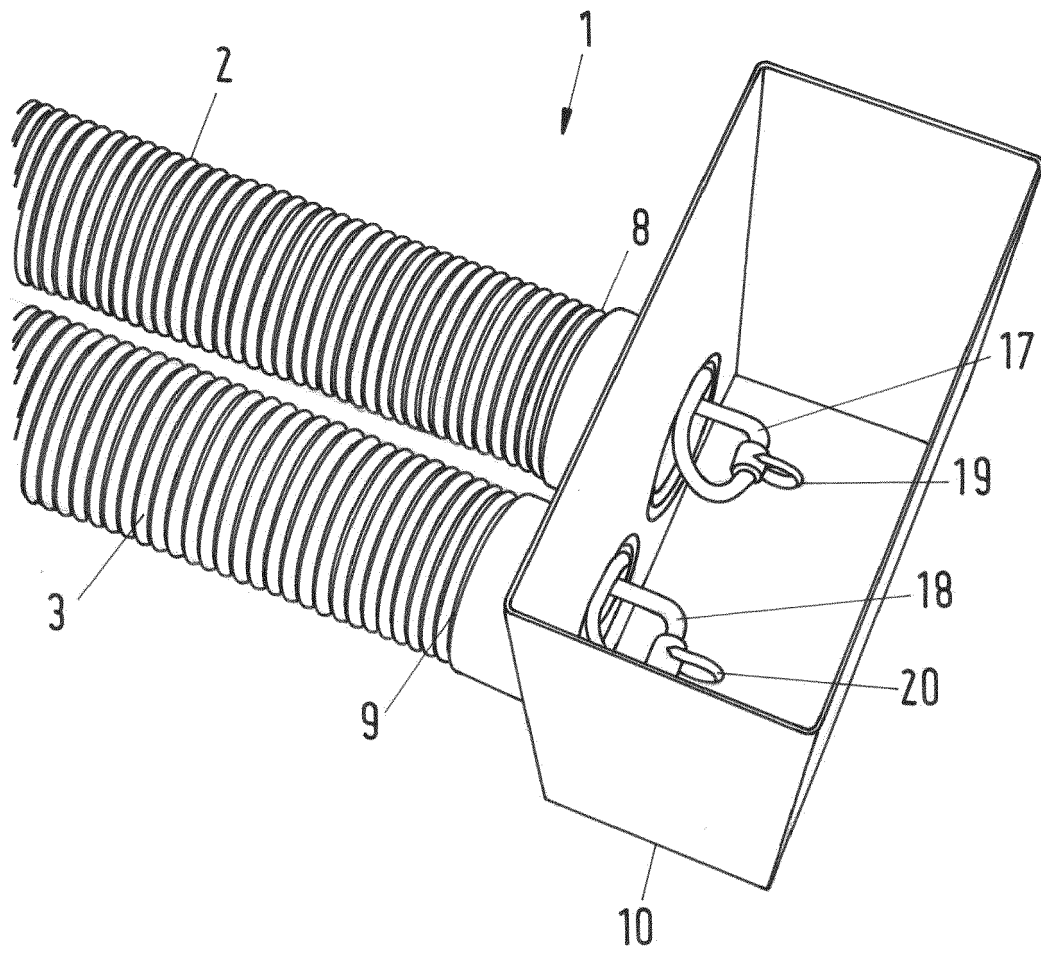


Fig.3

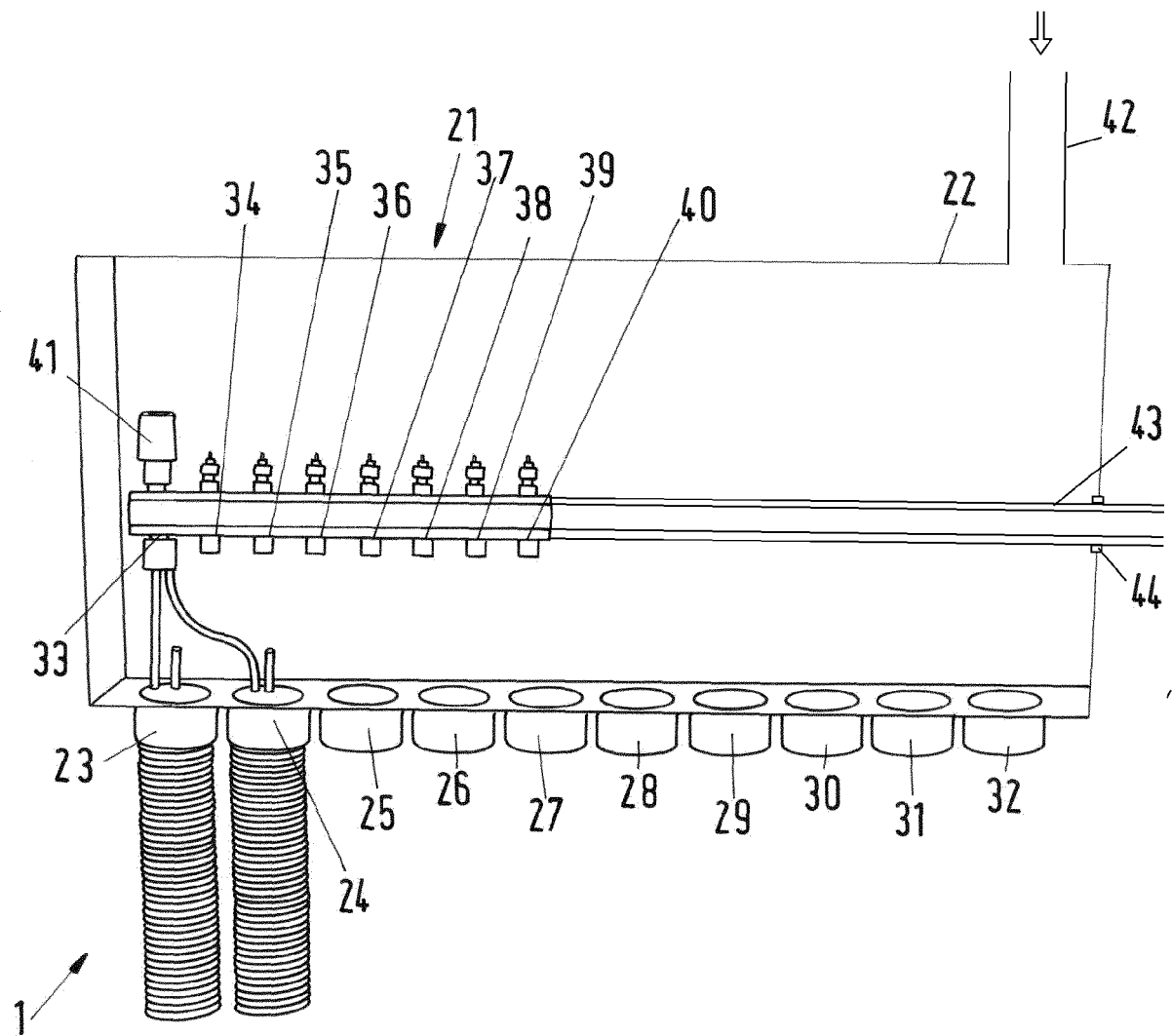


Fig.4



EUROPEAN SEARCH REPORT

Application Number
EP 18 19 9839

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2014/116657 A1 (RITCHIE MICHAEL CHARLES [US]) 1 May 2014 (2014-05-01)	1,2,4-14	INV. F24F13/30 F24F7/06 F24F13/02
A	* paragraph [0068] - paragraph [0075]; figures 4-5 *	3	
X	----- CN 105 444 468 A (WUHU MEIZHI AIR CONDITIONING EQUIPMENT CO LTD) 30 March 2016 (2016-03-30)	1,2,4-14	
A	* abstract; figures 1-4 *	3	
X	----- US 2001/029745 A1 (EVANS FRED [US]) 18 October 2001 (2001-10-18)	1-4,6-14	
A	* paragraph [0021] - paragraph [0022]; figures 1-3 *	5	
X	----- US 3 799 249 A (LINHARDT H) 26 March 1974 (1974-03-26)	1,4	
A	* column 2, line 35 - column 2, line 55; figure 1 *		
	----- CN 108 278 800 A (GREE ELECTRIC APPLIANCES INC ZHUHAI) 13 July 2018 (2018-07-13)	1-14	TECHNICAL FIELDS SEARCHED (IPC)
	* abstract; figures 1-7 *		F24F

The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 March 2019	Examiner Anconetani, Mirco
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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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 19 9839

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014116657 A1	01-05-2014	US 2014116657 A1	01-05-2014
		WO 2014064666 A1	01-05-2014

CN 105444468 A	30-03-2016	NONE	

US 2001029745 A1	18-10-2001	NONE	

US 3799249 A	26-03-1974	NONE	

CN 108278800 A	13-07-2018	NONE	

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5640951 A [0003]
- US 20050178755 A [0004]