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(71) Applicant: **GIANNONI S.r.l.**
Via Milano, 49/51
I-20079 Castiraga Vidardo (Milan) (IT)

(72) Inventor: **Mele, Flavio**
Via A. Boito 5
I-20075 Lodi-Milano (IT)

(74) Representative: **Falcetti, Carlo et al**
Jacobacci, Casetta & Perani,
Via Visconti di Modrone, 7
I-20122 Milano (IT)

(54) A plate-type heat exchanger control device assembly and related heat exchanger.

(57) A plate-type heat exchanger/control device assembly (1,21) and associated exchanger (1) for a heating system boiler of the combined type, comprising an exchanger provided with a closing plate (2) with a primary water inlet fitting (16) offset from corresponding plate openings (13) of the exchanger and at a predetermined spacing from a second sanitary water inlet fitting (7), attached to the closing plate (2) and a straight or three way switch valve (21) with hydraulic actuator coupled directly to the exchanger (1) by means of said fittings (7,16), with no elbow pipe connections therebetween, the spacing accommodation function being performed by the closing plate (2) with minimal bulk and simplified and reliable assembling.

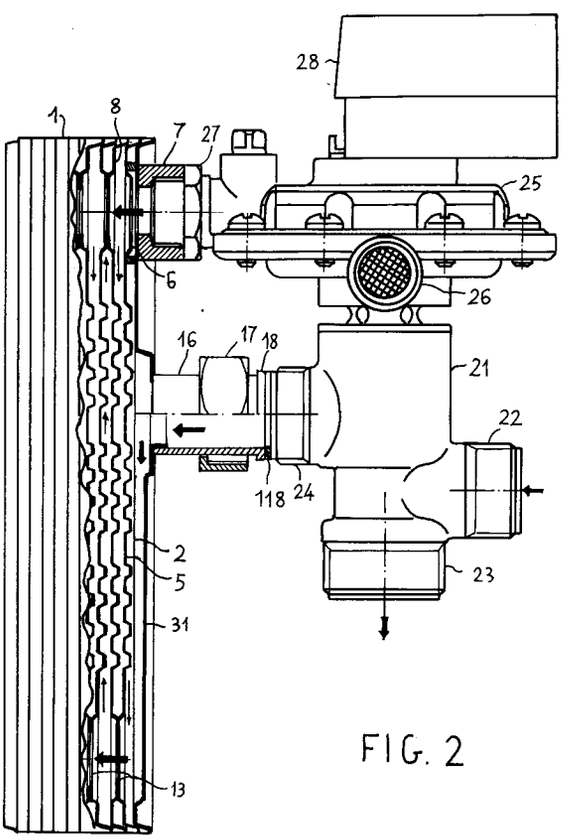

FIG. 2

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The present invention relates to a compact plate-type heat exchanger/control device assembly, easy to install and maintain, particularly intended for wall-mounted heating boilers of the combined type and associated exchanger.

It is known that self-contained heating systems are ever more often adopted for family dwelling buildings, to perform the dual functions of space heating in wintertime and producing hot water for household use.

The "heart" of those systems is the heat generator, which usually takes the form of a wall-mounted boiler and is to fill several basic demands, such as demands for reliability, efficiency, compactness, and ease of maintenance.

The essential components of a wall-mounted boiler include the heat exchanger between the primary fluid, i.e. the system heating circuit, and the sanitary fluid, i.e. the delivery water, as well as devices for controlling the primary flow through the exchanger to meet the demand for heated sanitary water.

It should be clear, in fact, that for efficient overall operation of the system, the primary fluid should only be supplied to the exchanger and transfer its heat contents to the sanitary fluid on actual demand for sanitary water, thereby to avoid wasted heat and load losses across the primary circuit while no actual demand for heated water exists.

These components should be compact and easy to install and maintain.

Plate-type heat exchangers have been known which are compact, efficient, occupy a very small volume of about of 80 x 180 x 35 mm, and comprise a plurality of plates juxtaposed to form two sets of intercalated flow-through chambers for the primary and the sanitary flows, respectively.

Such exchangers, which are generally parallelepipedic in shape, carry, on a larger rectangular face thereof, four unions for connection to delivery and discharge pipes, respectively for the primary and the sanitary fluid.

By reason of the exchanger construction and operability, the unions are positioned near the corners of the rectangular face, at aligned locations to internal openings arranged to put the chambers of one set into mutual communication.

This considerably restricts the possible coupling arrangements between the exchanger and the control device which is also provided, in general, with inlet/outlet unions for the primary and sanitary fluids whose relative spacings and mutual positions are dictated by different construction requirements.

Thus, intermediate connection elbows, or some other header arrangements, become necessary between the exchanger and the control device which expand the space requirements of the assembly, involve an increased number of tight unions, and make the assembly and disassembly operations for maintenance purposes more difficult to carry out.

Such intermediate connection pipes, or other header arrangements, cannot be implemented as integral parts of the exchanger or the control device because they would interfere with its production process and raise costs.

In any event, they would not remove the problem of increased assembly bulk.

This drawback is obviated by the plate-type exchanger/control device assembly and associated exchanger of the present invention, wherein a direct connection is established between the exchanger and the control device without using any elbow-type interconnection pipes between the two elements.

According to the invention, these results are obtained by the provision of a heat exchanger wherein an end closing plate of the exchanger, being an integral part of the exchanger, forms in combination with an adjoining plate of the exchanger a distribution chamber for the primary (or sanitary) fluid, the end closing plate being provided with a first opening which is connected in a tight fashion to and coaxial with a corresponding opening in the adjoining plate for admitting sanitary (or primary) fluid into the exchanger, the end closing plate being further provided with a second opening offset from the openings in the exchanger plate.

The closing plate is provided, at the locations of the two openings, with first and second axial fittings along a perpendicular axis to the plane of the plate with a predetermined spacing between centers of the fittings which is equal to the distance between centers of a sanitary fluid outlet from a primary fluid outlet of the control device, usually a switch valve (three way valve) or straight valve with a hydraulic actuator, thereby providing a direct connection between the exchanger and the control device with no intervening elements and using a single tight union for each flow route.

In this way, a compact and inexpensive assembly can be provided which is simple to assemble and only requires that two unions be tightened as against four.

According to a further aspect of the invention, the manufacturing dimensional tolerances of the two elements which make up the assembly are accommodated by the provision of a coupling comprising a sleeve-type fitting on the end plate and a union to be threaded in the sleeve for the outlet fitting of the sanitary fluid from the control device, thereby achieving accurate axial positioning of the two elements, while the primary circuit coupling is accomplished by means of a ring nut clamp-down threaded sleeve being juxtaposed end-to-end through an intervening sealing gasket to an outlet

union for the primary fluid from the control device (which coupling would allow for some misalignment of the elements).

Advantageously, though not necessarily, the closing plate is also provided with outlet fittings for the sanitary fluid and the primary fluid from the exchanger, either or both of which may be provided on the opposite face of the exchanger from that of the closing plate.

The features and advantages of the invention can be more clearly understood from the following description of a preferred embodiment thereof and the accompanying drawings, in which:

Figure 1 is a front end view of an exchanger closing plate for an exchanger/control device assembly according to the invention; and

Figure 2 is a side view, partly in section along a plane I-I in Figure 1, of the exchanger/control device assembly according to the invention.

With reference to the drawings, the exchanger 1 comprises a plurality of flat plates of metal, preferably stainless steel, which are substantially rectangular in shape and formed, as by deep drawing, with ribs as well as with a pyramid-shaped rim, also obtained by deep drawing, around their peripheries.

The plates are juxtaposed to one another into a stack of plates between which flow-through chambers are defined.

Each of the plates, except an end plate, is provided with four openings located near the plate corners and being each surrounded by an embossed collar formed by deep drawing on either one or the other face of the plate for contacting a corresponding collar on an adjoining plate.

The plate rims and contact collars are joined together by a conventional brasing process to form two sets of chambers.

Preferably, as shown in Fig. 1, the plates have at least the sides 29,30 of greater length slighty rounded or convex, so as to form a conoidal rim. The rim conoidal shape provides a more precise and tight coupling among juxtaposed rims and tightness of the brazed seam.

All the chambers in one set are communicated together through a pair of coaxial openings and form a circuit for a primary and a secondary flow, respectively, which will exchange heat in countercurrent relationship.

In accordance with the invention, the exchanger is provided with a closing plate 2, shown in front view in Figure 1, which is juxtaposed to an underlying plate 5.

The plate has the same dimensions as the other plates of the exchanger but preferably increased thickness, e.g. of 0.8 mm, and is provided with a first opening 3 located near a corner (the upper left corner in Figure 1) of the plate.

The opening 3 is surrounded by a dimpled collar 4, formed by deep drawing, which is attached to a corresponding collar 6 of the adjoining plate 5 as by brazing.

Alternatively, and with no need to have the collar 4 dimpled, this may be attached to the collar 6 of the plate 5 using a brazed-on ring of appropriate thickness therebetween.

An inside-threaded sleeve union 7 or another type of connection is attached to the closing plate 2, at the location of the opening 3, using known means such as a brazed joint.

The opening 3 provides an inlet route for sanitary fluid into a chamber formed between the plate 5 and an adjoining plate 8, as well as into all the chambers of one set.

Preferably, though not necessarily, the plate 2 is provided with a second opening 9, which is identical with the former and is also provided with a collar 10 and sleeve union 11, for discharging sanitary (heated) water from the chambers to the hot water distribution network.

The opening 9 is located near the opposite corner of the plate from that having the opening 3 nearby, so that the sanitary flow will be forced to flow through the exchanger chambers along the direction of greater spread of the chambers.

As previously mentioned, the opening 9 could be also formed in a closing plate opposite from the plate 2.

According to the invention, the plate 2 is provided with a third opening 12 for admitting primary fluid into the exchanger.

This opening 12, rather than lying coaxial with the exchanger openings arranged for that purpose, as indicated by the phantom line 13 in Figure 1, is provided at an offset location on the plate 2, a predetermined distance center to center from the opening 3 which is equal to the distance between centers separating corresponding sanitary and primary water outlets of a straight or three way switch valve to be coupled to the exchanger.

Thus, the opening 12 will locate close to the plate centerline.

The opening 12 is also surrounded by a collar 14, embossed on the plate and carrying a fitting 15 conventionally attached thereto as by brazing.

The fitting 15 comprises, as shown in Figure 2, an axial sleeve 16 provided with a clamp-down ring nut 17 and a but flange 18 co-operating with an abutment on the ring nut to form a but joint having a sealing gasket 118 therebetween.

Thus, the opening 12 constitutes an inlet route for primary water into the distribution chamber formed between the closing plate 2 and the adjoining plate 5.

Through this chamber, the primary water can flow to the openings 13 in the exchanger and

thence into the set of chambers for the primary flow.

Preferably, though not necessarily, in order to provide a greater flow section and minimize pressure drops, the embossed collar 14 is lengthened to form an embossed channel 31 extending up to a plare zone juxtaposed to the openings 13.

Preferably, though not necessarily, the plate 2 is provided with a fourth opening 19 for letting out the primary water from the exchanger.

The opening 19 is located opposite to the openings 13 and coaxial with corresponding openings formed in the exchanger plates wherethrough the primary water can be directed outside.

An inner insulation ring, attached to the plate 2 and a collar of the plate 5 (in turn, attached to a corresponding collar on the plate 8) as by brazing, insulates the opening 19 of the distribution chamber while communicating it to the primary fluid chambers.

At the location of the opening 19, the plate 2 is provided with a sleeve union 20 similar to the sleeve 7 but provided of preference with an outside threadway for coupling to a primary fluid recovery pipe and directing the fluid to a delivery pump at the boiler.

As previously mentioned, the opening 19 could also be provided in an end plate remote from the plate 2.

A closing plate so constructed leads to the implementation of an assembly exchanger/switch valve (and more generally, a control device) which is easy to assemble and extremely compact, as illustrated by Figure 2.

The switch valve comprises a valve body 21 having a threaded inlet union 22 for the primary water, a first threaded outlet union 23 for delivering primary water to the heating circuit, and a second threaded outlet union 24 for delivering primary water to the exchanger.

The union 24 is juxtaposed axially to the sleeve 16, and the ring nut 17 is threaded onto the sleeve 24.

The primary flow is controlled internally of the body 21 by a shutter, not shown, which can be moved between two positions to direct the inflow to one or the other of the valve outlets according to its position setting.

The switch valve is completed by a conventional actuator device 25 of the diaphragm type, whose operation is based on the pressure differential which is established between two chambers separated by a diaphragm and respectively communicated to a water inlet 26, for sanitary water in this instance, and an outlet, when a (optionally adjustable) neck, provided between the inlet and the outlet, produces a dynamic pressure loss, hence a pressure differential, in the presence of a flow rate above a threshold value, whereas the pressure differential would be zero at no or minimal flow rate.

The pressure differential causes the diaphragm to deform and move an actuating rod attached to the diaphragm.

The rod, being slidable in a seat provided with sealing gaskets, will act on the shutter.

The outlet union 27 for the sanitary water from the actuator is threaded into the sleeve 7.

The distance between centers of the union 27 from the union 24, having parallel axes, is equal to the center-to-center spacing of the exchanger sleeves 7 and 16, whereby the coupling of the two elements, the exchanger and the switch valve, or more generally the flow control device, will be a direct one with no elbow fittings therebetween which would greatly increase the assembly bulk and make assembling and disassembling for maintenance more difficult.

Therefore, it should be clear that the function of adapting the distance between centers of one element (the exchanger) from the other (the switch valve) is performed by a distribution chamber of minimal bulk which is formed by a closing plate as described, to thereby afford the added advantages of a smaller number of tight joints having to be clamped down, improved reliability of the assembly, and simpler assembling and disassembling procedures.

The control device may include, additionally to local actuation mechanisms, devices for controlling remote elements, such as a microswitch 28 to be operated by the actuator 25 to control such remotely located elements as pumps and solenoid valves.

With the space heating function shut off in summertime, for instance, the system would only be expected to supply hot water on demand.

Accordingly, the system would expediently be operated for just those time periods while a demand for hot water exists.

The foregoing description only covers a preferred embodiment of an exchanger/control device assembly wherein the control device consists of a switch valve with a hydraulic actuator, and many changes may be made thereunto without departing from the spirit of the invention.

In particular, the switch valve may be replaced by a valve mounted in the primary flow return line to the boiler and connected directly to the exchanger outlet for the primary flow, whilst the exchanger primary inlet would be connected directly to the boiler water system.

The valve may be controlled by a hydraulic actuator of the kind described above, wherein a differential pressure is arranged to act on a diaphragm.

In this case, the closing plate can accommodate the distance between centers of the exchanger primary fluid outlet from the exchanger sanitary fluid inlet to enable direct coupling of the valve and its associated actuator to the exchanger.

Of course, the valve could be connected directly to the exchanger primary fluid inlet by its primary fluid outlet.

In a still more general way, while it is preferred that the hydraulic actuator be supplied with cold sanitary fluid, and therefore, placed upstream of the exchanger, there would be no substantial objection to its installation downstream from the exchanger, and therefore, connected to the sanitary outlet of the exchanger.

In all of the foregoing instances, the closing plate of the exchanger would ensure accommodation of the distance between centers of two openings in the exchanger by means of a distribution chamber of minimal bulk, on the order of a few millimeters, and allow direct connection of the control device, it being immaterial which of the (inlet/outlet, primary/sanitary) openings in the closing plate is offset from corresponding openings in the exchanger plates.

Finally, whether the valve is mounted in the delivery or the return line, the actuator could be, rather than of the hydraulic type, an electromechanical or thermomechanical or the like type driven by a flow rate sensor.

In this case, the closing plate with offset connection from corresponding openings in the exchanger plates would enable an integrated exchanger/control device assembly to be provided, with the device being connected directly to the exchanger with no intervening elbow connections or else into a compact and reliable arrangement, even if no direct connection need to be provided for the control device to the sanitary circuit of the exchanger, so that the closure plate could be formed, in the extreme, with one opening with an inlet/outlet fitting for direct connection to the control device while the other three inlet/outlet openings could be provided, along with their respective fittings, wholly or in part in the end plate of the exchanger plate bank opposite from the closing plate.

Claims

1. A plate-type exchanger/control device assembly (1,21) of the type in which a bank of plates (5) approximately rectangular in shape and provided with four openings near their apices form a plurality of heat exchange chambers for the exchange of heat between a primary fluid and a sanitary fluid respectively admitted into and tapped off two discrete sets of said chambers, respectively through a pair of said openings, and a control device (21) is coupled to said exchanger (1) to control the flow of primary fluid to said exchanger according to the demand for tapped sanitary fluid, characterized in that it comprises:

a closing plate (2) for said exchanger (1) forming, by juxtaposition and attachment to a first (5) of said plates, a distribution chamber for one of said fluids, said closing plate (2) being provided with:

a first opening (3) tightly connected to and coaxial with a corresponding opening in said first plate (5) to admit/discharge one of said fluids into/from said exchanger,

a second opening (12) offset from the openings (13) in said plates, at a distance from the center of said closing plate which is smaller than the distance of said openings (13) from the center of the associated plates and at a predetermined distance away from said first opening (3),

first (7) and second (16) axial fittings with perpendicular axes to said closing plate (2), being fast with said closing plate and respectively coaxial with said first (3) and second openings (12) for releasable connection of a control device (21), and

a control device (21) provided with a primary fluid inlet (22), at least one primary fluid outlet (24), a sanitary fluid inlet (26) and a sanitary fluid outlet (27), and

control means (25) responsive to the sanitary fluid flow rate through said control device to allow a primary fluid flow between said primary flow inlet (22) and outlet (24) at a sanitary flow rate above a predetermined level, said primary fluid inlet (22) or outlet (24) of said device being connected directly to one of said first (3) and second (12) openings in the closing plate (2) by means of its corresponding first (7) or second (16) axial fitting, said sanitary fluid inlet/outlet (26,27) of said device being connected directly to the other of said first and second openings in the closing plate by means of its corresponding first or second axial fitting.

2. An assembly as in Claim 1, wherein one of said first (7) and second (16) fittings comprises a first sleeve (7) fast with said closing plate (2) and provided with an inside threadway and an end abutment for threaded engagement by an outside-threaded union (27) of said control device, and the other (16) of said first and second fittings comprises a second sleeve (16) fast with said closing plate, and a clampdown ring nut (17) fitted over said second sleeve, inside-threaded and formed with an abutment

shoulder co-operating with an annular abutment extension (18) of said second sleeve, for but connection to an outside-threaded union (24) of said control device, with a sealing gasket (118) therebetween.

3. An assembly as in the preceding claims 1,2, wherein said closing plate (2) has a third opening (19) therein which is insulated from said distribution chamber in sealed relationship therewith and open into a heat exchange chamber of a first of said two chamber sets, and a third axial fitting (20) with a perpendicular axis to said plate, fast with said plate, and coaxial with said third opening (19).

4. An assembly as in the preceding claims, wherein said closing plate has a fourth opening (9) insulated from said distribution chamber in selaed relationship therewith and open into a heat exchange chamber of a second of said two chamber sets, and a fourth axial fitting (11) having a perpendicular axis to said closing plate (2) and being coaxial with said fourth opening (9).

5. A plate-type heat exchanger (1) for forming an integrated exchanger/control device assembly, of the type in which a stack of plates approximately ractangular in shape and provided with four openings near their apices form a plurality of heat exchange chambers for the exchange of heat between a primary fluid and a sanitary fluid which are admitted into and tapped off two discrete sets of said chambers respectively, each through a pair of said openings, respectively, and a control device (21) coupled to said exchanger controls the flow of primary fluid through said exchanger according to demand for tapped sanitary fluid, characterized in that it comprises:

a closing plate (2) for said exchanger forming, by juxtaposition and attachment to a first (5) of said plates, a distribution chamber for one of said fluids between a first opening (12) in said closing plate (2), which opening (12) is offset from the openings in said plates (5) and an opening (13) in said first plate (5), and

an axial fitting (16) having a perpendicular axis to said closing plate (2) and fast therewith for releasable connection to a first union (24) of a control device.

6. A plate-type exchanger (1) as in Claim 5, characterized in that said closing plate (2) is provided with a second opening (3) insulated from said distribution chamber, coaxial with an opening in said first plate (5) and communicating with this, and a second axial fitting (7) having a perpendicular axis to the plane of said closing plate (2) for releasable connection to a second union (27) of said control device, the mutual spacing between centers of said first and second fittings (7,16) being predetermined and equal to the spacing between centers of said first and second unions (24,27).

7. A plate-type exchanger as in Claim 6, characterized in that said distribution chamber formed by said closing plate (2) and said first plate (5) is in communication with the set of primary fluid chambers of said exchanger and said second fitting (7) is in communication with the set of sanitary fluid chambers of said exchanger through said coaxial opening in said first plate (5).

8. A plate-type exchanger as in Claim 6, characterized in that said distribution chamber formed by said closing plate (2) and said first plate (5) is in communication with the set of sanitary fluid chambers of said exchanger and said second fitting (7) is in communication with the set of primary fluid chambers of said exchanger through said coaxial opening in said first plate (5).

9. Plate-type exchanger as in claims 5,6,7,8, where the plates of said stack and said closing plate (2) have an embossed frame with at least the sides (29,30) of greater lenght convex and forming a conoidal surface.

10. Plate-type exchanger as in claims 5,6,7,8,9, where said closing plate (2) comprises an embossed channel (31) extending between said first offset opening (12) and a closing plate zone juxtaposed to an opening (13) of said stack plates.

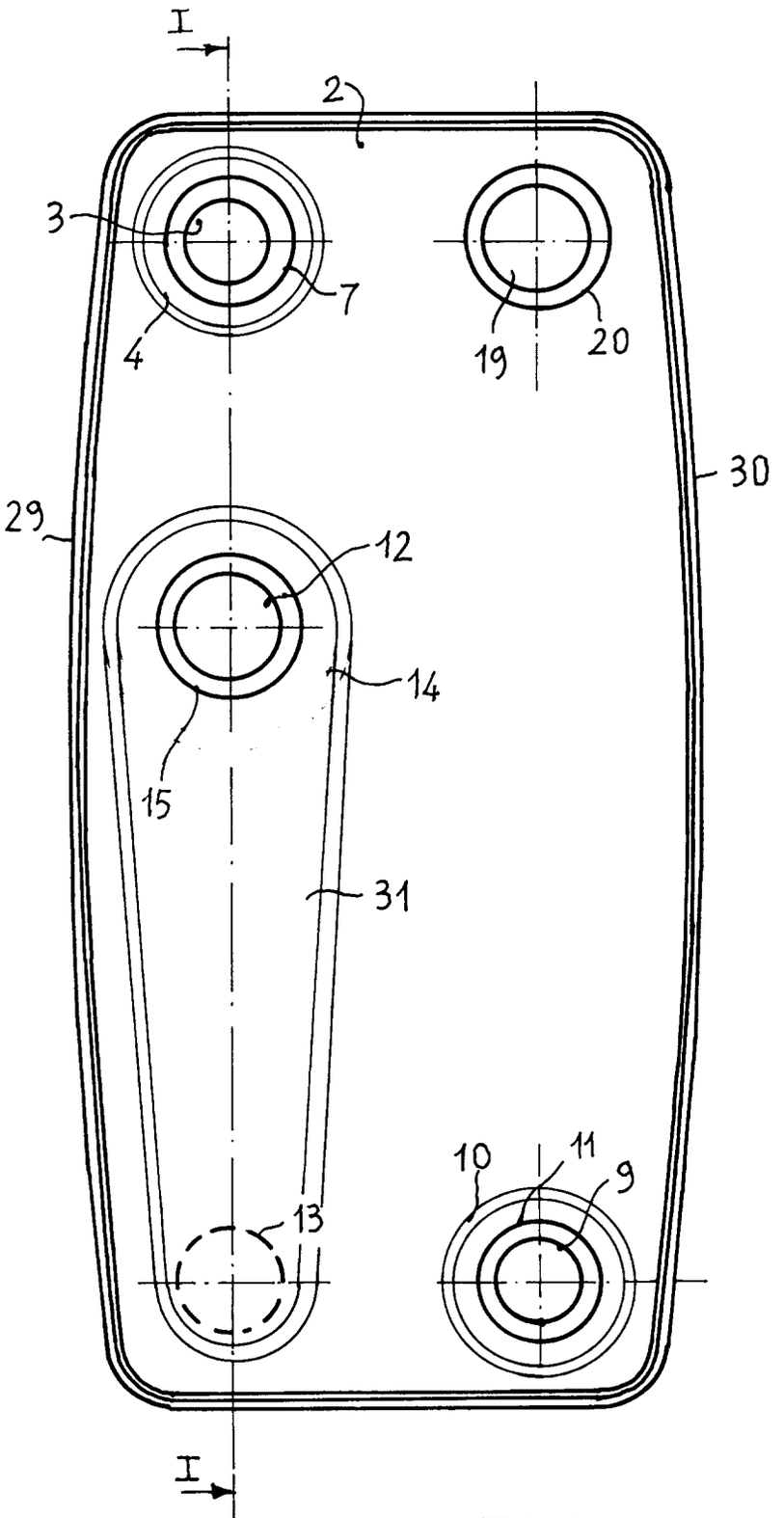

FIG. 1

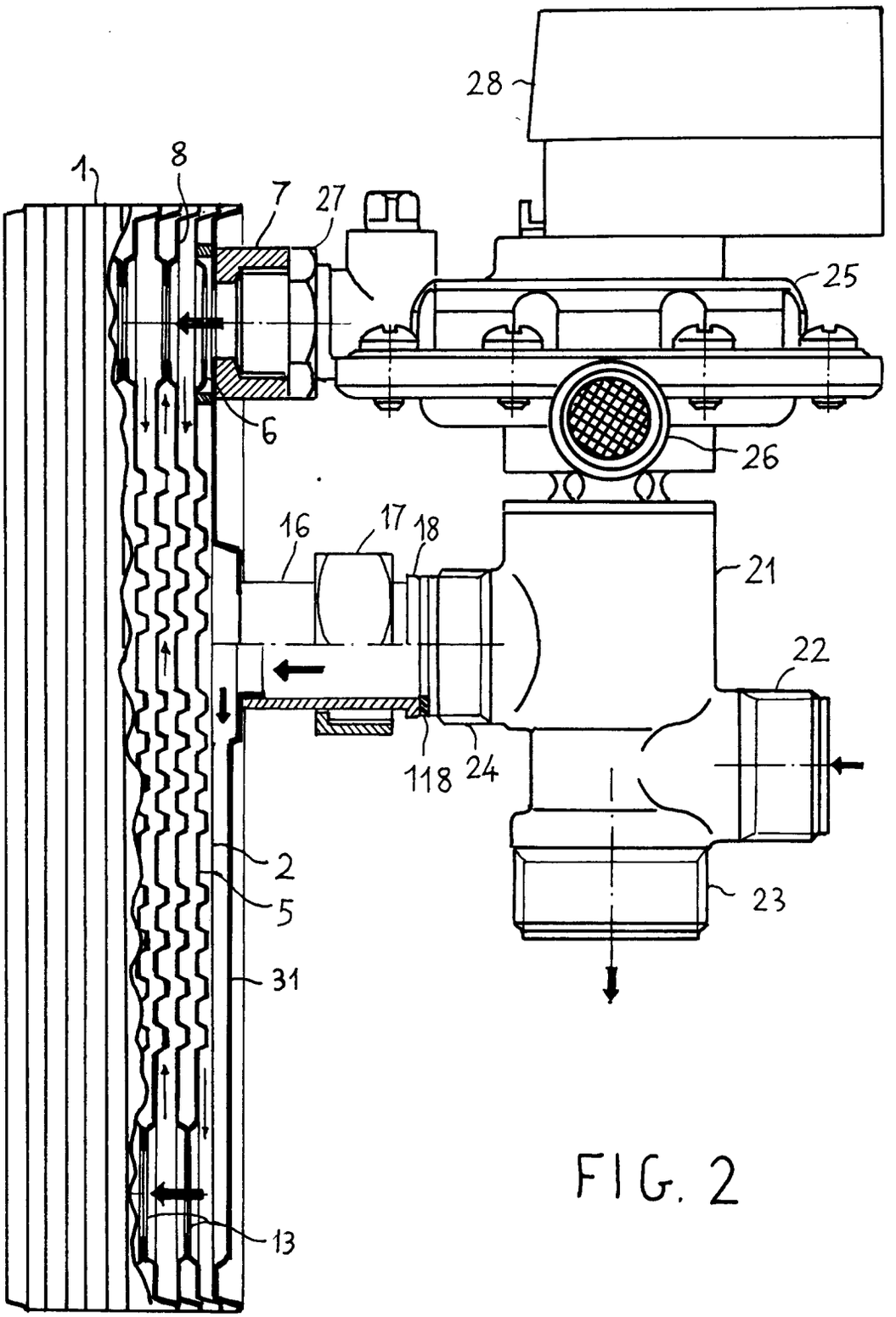

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 93 20 3712

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	GB-A-2 234 337 (MADIGAN) * page 5, line 9 - page 6, line 23; figures 1,2 * ---	1,5	F28D9/00 F28F27/00 F24D3/08
A	US-A-5 042 577 (SUZUMURA) * column 2, line 59 - column 4, line 45; figures 1,2,5,6 * ---	1,5	
A	GB-A-2 213 242 (GIANNONI SRL) -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

F28D
F28F
F24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 June 1994	Beltzung, F

CATEGORY OF CITED DOCUMENTS

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