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(71) Applicant: **Invensys Process Systems A/S**
8600 Silkeborg (DK)

(72) Inventor: **Jensen, Tage Erland**
6100 Haderslev (DK)

(74) Representative: **Andersen, Poul Hoeg et al**
Zacco Denmark A/S,
Hans Bekkevolds Allé 7
2900 Hellerup (DK)

(54) A coupling element for a heat exchanger

(57) The invention relates to a plate water heater (1) comprising a coupling element (3) and a plurality of heat exchanger plates combined to form a plate stack (2a) and configured in such a manner that, between adjoining heat exchanger plates, separate flow passages are formed for conveyance of a heat-emitting liquid and a heat-absorbing liquid, respectively, said coupling element (3) comprising flow channels (21, 22, 23, 24) for conveyance of liquid between the flow passages and the couplings (7, 8, 9, 10), and regulator means (6) for regulating the liquid flow in the heat-emitting liquid. Thereby it is accomplished that there will always be hot liquid in the flow channel for heat-emitting liquid (the primary circuit) immediately the need arises for liquid to be heated in the secondary circuit. This need for hot water will be particularly pronounced in cases where the plate water heater is used for heating utility water.

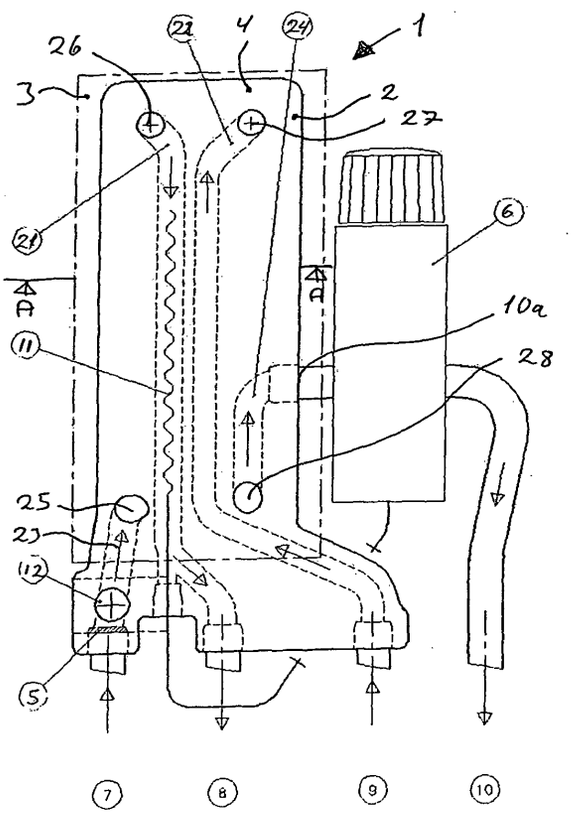

Fig 2a

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Description

Introductory part

[0001] The present invention relates to a plate water heater, comprising a coupling element and a plurality of heat exchanger plates combined to a stack of plates and configured in such a manner that, between adjoining heat exchanger plates, separate flow passages are formed for conveying a heat-emitting liquid and a heat-absorbing liquid, respectively, said coupling element comprising flow channels for conveying liquid between the flow passages and the couplings and regulator means for regulating the flow of liquid in the heat-emitting liquid.

Background of the invention

[0002] A plate water heater typically comprises a plate heat exchanger, at least one regulator valve with one or more sensors and couplings for heat-emitting liquid, typically water from central heating plants, couplings for heat-absorbing liquid, typically utility water or liquid medium in a central heating plant. The plate heat exchanger comprises a primary circuit and a secondary circuit formed by a plurality of heat exchanger plates being configured in such a manner that separate flow passages are provided between adjoining heat exchanger plates for a heat-emitting liquid in the primary circuit and for a heat-absorbing liquid in the secondary circuit, respectively.

[0003] Plate heat exchangers lend themselves for use in connection with central heating plants and typically within the context of central heating plants for small units such as eg one-family houses, villas, flats, where it serves either as plate water heater for heating the utility water, or as plate water heaters for heating a liquid medium used in the central heating system of that unit.

[0004] Typically plate water heaters are used in a context where it is desired to have a central heating installation with a water heater having limited outer dimensions compared to a conventional water heater that often features a receptacle volume of about 100-200 litres of utility water. In cases where a plate water heater is used for heating utility water, cold utility water is conveyed into the secondary circuit of the plate heat exchanger. In the primary circuit hot central heating water is conveyed that emits the heat contained therein by heat transmission to the cold utility water in the secondary circuit, whereby the utility water is heated.

[0005] In cases where a plate heat exchanger is used for heating the liquid medium in a central heating plant, hot central heating water is conveyed through the primary circuit while emitting the heat contained therein by heat transmission to the heat-absorbing liquid in the secondary circuit. The heat-absorbing medium thus heated is then recycled to the central heating plant.

[0006] Plate heat exchangers are known from eg patent No. EP 120 319. Such plate heat exchanger has couplings for supply and discharge of liquid at the corners of an end plate, onto which couplings conduits, valves and other equipment are coupled.

[0007] WO 99/54665 teaches a through-flow water heater with a sophisticated coupling element composed of a number of plate parts with flow channels in several layers.

The problem of the prior art solution

[0008] It is the problem of the prior art that the coupling element is of a rather sophisticated construction. At the same time the regulation of temperature of the heat-absorbing liquid (ie most often the utility water) is difficult to control. In particular in those cases where there is only a modest or no consumption whatsoever of hot water, it is still required that that a certain amount of heat-emitting liquid is circulated through the through-flow water heater in order to maintain a desired temperature in the plate water heater. In those cases control is primarily exercised to maintain the desired temperature in the plate water heater — also designated "regulation without charge". Owing to the particular configuration of the plate water heater according to the prior art, quite a large amount of heat-emitting liquid is circulated in the primary circuit. Moreover, large requirements are made to the accuracy of the regulator valve controlling the liquid-throughput of the heat-emitting liquid. Of course, this is inconvenient as the regulation involves a large consumption of heat-emitting liquid (central-heating water) to maintain a desired temperature of the utility water (the heat-absorbing liquid) in the coupling element.

[0009] It is therefore an object of the invention to provide a plate water warmer with a coupling element, being of a simpler construction and simultaneously enabling a simpler way of regulating the temperature of the heat-absorbing liquid (the secondary circuit), while simultaneously requiring a smaller throughput of heat-emitting liquid through the coupling element.

[0010] This is achieved by the invention as featured in the characterising parts of claim 1 and claim 8.

Detailed description of the invention

[0011] Hereby a plate water heater with a coupling element is accomplished wherein a heat transmission occurs from the liquid in the flow channel for supply of heat-emitting liquid to the flow channel for the heat-absorbing liquid already.

[0012] It is thereby enabled that the temperature of the heat-absorbing liquid in the flow channel for conveyance of the heat-absorbing liquid is elevated more quickly and simultaneously reaches a desired value already before the temperature of the remainder on the plate heat exchanger has reached the same level. Moreover, there is no need for conveying a quite large amount of heat-emitting liquid through the primary circuit (flow

channels/flow passages for the heat-emitting liquid) to maintain a desired temperature level in the secondary circuit (flow channels/flow passages for the heat-absorbing liquid).

[0013] Since, precisely, there are relatively long periods of no consumption or only a quite modest consumption of heat-absorbing liquid (hot utility water) the temperature of the heat-absorbing liquid and the heat-emitting liquid will drop slowly. Therefore, at intervals, it will be necessary to convey heat-emitting liquid into the flow channel in order to be able to maintain the desired temperature level in the coupling element, and in particular in the flow channel for heat-absorbing liquid — where also the sensor is configured. Since a heat transmission is taking place already in the flow channels, it will not be necessary to have to convey a quite large amount of heat-emitting liquid through both the coupling element and the stack of heat exchanger plates before the sensor registers that the desired temperature level in the heat-absorbing liquid (the utility water) allowed to stand in the flow channel is reached. Then the liquid flow of heat-emitting liquid is again shut off. It is hereby accomplished that exclusively a minimal and requisite amount of liquid is circulated in the flow channel/the flow passages (primary circuit) to heat the amount of heat-absorbing liquid allowed to stand in the flow channel.

[0014] From an overall perspective, reduced consumption of heat-emitting liquid thus for maintaining the temperature at a desired level in the secondary circuit results from the invention.

[0015] Thereby it is ensured that there will always be hot liquid in the flow channel immediately a need arises for heating liquid in the secondary circuit. This need for hot water will be particularly pronounced in cases where the plate water heater is used for heating utility water.

[0016] It is a further advantage of the invention that, by configuring the coupling element with suitable flow channels for conveyance of heat-emitting and heat-absorbing liquid, it is possible to accomplish a considerable reduction in the need for conduits and fittings. Likewise, the number of sealing plates subject to leaks can be reduced.

[0017] Advantageous embodiments of the invention will appear from the dependent claims.

[0018] The invention will now be described with reference to the drawing, wherein:

Figure 1 shows a flow chart of a plate water heater; and

Figure 2a shows a first embodiment of a plate water heater according to the invention;

Figure 2b shows a lateral view of the plate water heater shown in Figure 2a; and

Figure 2c shows a further lateral view of the plate water heater shown in Figure 2a; and

Figure 3a shows an alternative embodiment of a plate water heater according to the invention; and

Figure 3b is a sectional view through the plate water heater shown in Figure 3a along the line A-A.

Detailed description of the figures

[0019] Thus, Figure 1 shows a flow chart of a plate water heater 1 comprising a plate heat exchanger 2 with a primary circuit 13 for heat-emitting liquid and a secondary circuit 14 for heat-absorbing liquid. The primary circuit 13 comprises a coupling for supply 9 and a coupling for discharge 10, respectively, of heat-emitting liquid and is configured with regulator means 6 (regulator valve) 6 at the coupling for discharge 10. The regulator means 6 comprises a temperature sensor 11 configured for registering the temperature at the coupling for discharge 8 of liquid in the secondary circuit 14 and will, when the temperature in the secondary circuit 14 has dropped to a pre-set level, open to allow through-flow of liquid in the primary circuit 13 in order to thereby increase the temperature in the secondary circuit 14 to the pre-set level.

[0020] The secondary circuit 14 comprises a coupling for supply 7 and a coupling for discharge 8 of heat-absorbing liquid. Moreover, on the secondary circuit 14, a safety valve 16, a further coupling 16 for establishing liquid circulation and a non-return valve 15 are provided.

[0021] In the flow chart, the plate water heater is shown coupled in such a manner that the liquid is conveyed counter-currently through the plate heat exchanger — ie in such a manner that, when the liquid flows through the plate heat exchanger — there is the largest possible temperature potential between the liquid in the primary circuit and the liquid in the secondary circuit.

[0022] Thus, in a preferred embodiment Figure 2a shows a plate water heater 1 according to the invention. The plate water heater 1 comprises a plate heat exchanger 2, couplings for heat-emitting liquid 9, 10 and couplings for heat-absorbing liquid 7, 8, regulator means 6 (regulator valve) with a sensor 11 configured for registering the temperature in the heat-absorbing liquid in the secondary circuit 14.

[0023] The plate heat exchanger 2 comprises a plurality of heat exchanger plates (not shown) that combine to form a plate stack 2a and are configured in such a manner that, between adjoining heat exchanger plates, separate flow passages are formed for a heat-emitting liquid in a primary circuit 13 and for a heat-absorbing liquid in a secondary circuit 14, respectively. The plate water heater 1 also comprises a coupling element 3 connected on the stack of heat exchanger plates in such a manner that each of the flow channels 21, 22, 23, 24, configured in the coupling element is in liquid contact with a channel opening 25, 26, 27, 28 configured in a lateral face 4 of the plate heat exchanger 2.

[0024] The coupling element 3 is configured with the couplings 7, 8, 9 configured at a first edge of the coupling element 3 and a coupling 10a configured at a second edge of the coupling element 3. On the coupling 10a are shown coupled regulator means 6 with a tubular connection taken down in level with the couplings 7, 8, 9 configured at the first edge.

[0025] A cold heat-absorbing liquid is conveyed into the coupling 7 and via the flow passage 23 in the coupling element further through the channel opening 25 into the flow passages of the secondary circuit in the in plate heat exchanger 2. Following heating in the secondary circuit, ie preferably in the flow passages in the plate heat exchanger, the now heated liquid is conveyed out via the channel opening 26 through the flow channel 21 in the coupling element, in which flow channel the sensor 11 for registration of the temperature of the liquid is configured. The flow channel 21 is moreover connected to the coupling 8 at the first edge of the coupling element.

[0026] Correspondingly heat-emitting liquid is conveyed into the coupling 9 and via the flow channel 22 in the coupling element through the channel opening 27 into the flow passages of the primary circuit in the plate heat exchanger 2. Following emission of the contained heat to the liquid in the flow passages of the secondary circuit, the now cooled liquid is conveyed out via the channel opening 28 through the flow channel 24 in the coupling element to the coupling 10a, on which coupling 10a the regulator means 6 are configured. Following emission of the contained heat, the heat-emitting liquid is conveyed through the regulator valve 6 and out through the coupling 10.

[0027] The flow passages 21, 22 extend in parallel for a considerable distance of the coupling element and extend in a plane essentially in parallel with the heat exchanger plates. Advantageously the heat-emitting liquid and the heat-absorbing liquid are conveyed in opposite directions through said flow channels 21, 22, where a particularly effective heat transmission is accomplished.

[0028] Advantageously the parallel flow channels 21, 22 can extend across from 40% to 80% of the longitudinal expanse of the coupling element 3, and further advantageously from 50% to 70% of the length of the coupling element 3, and most advantageously between 55% and 65% of the length of the coupling element 3. In Figure 1, the parallel flow channels constitute 60% or approximately 60% of the length of the coupling element 3.

[0029] Configuration of the flow channels 21, 22 adjoining each other as shown in figure 2 and also further advantageously manufacture of the coupling element of a material possessing high thermal conductivity enable good thermal contact between the liquids in the primary circuit and the secondary circuit, respectively. This good thermal contact is advantageous as an effective regulation when no consumption of liquid takes place in the secondary circuit (consumption of hot water) — also referred to as regulation without charge. When the liquid in the flow channel 21 is cooled (gives off the heat contained therein), a cooling of the liquid in the flow channel 22 will correspondingly take place via the thermal conductivity. This is registered by the sensor 11, whereby the regulator valve 6 will open for supply of hot liquid to the primary circuit. Thereby it is ensured that there will always be hot liquid in the flow channel immediately a need arises for heating of liquid in the secondary circuit — most often this will be the case when the plate water heater is used for heating utility water.

[0030] Figure 2b shows a lateral view of the plate water heater shown in Figure 2a. The coupling element 3 is shown mounted on a face that will preferably be a vertical face, such as eg a wall. At a first side face 4, the plate stack 2a of heat exchanger plates is shown connected to the coupling element 3. An an opposite second side face 4a, the plate stack of heat exchanger plates is connected to a further coupling element 3a, wherein said second coupling element in the figure is configured as an end plate with no couplings. The arrows 29 schematically show the path of the liquid in the primary circuit and the secondary circuit, respectively. The reference numeral 13 designates a safety valve that can advantageously be provided on the coupling element.

[0031] Figure 2c shows a further lateral view of the plate water heater shown in Figure 2a along the line A-A. In the Figure, the coupling element 3 is shown made of a single processed blank configured with a suitable number of couplings 7, 8, 9, 10a at an edge of the coupling element and with flow channels 21, 22, 23 in the coupling element. However, the coupling element 3 could also be manufactured by two or more plate parts being joined, wherein at least two of the plate parts are joined at a joining face (not shown) that essentially follows a plane in parallel with the heat exchanger plates. The joining face will preferably be configured to cut through the flow channels in the coupling element. Thereby it will be possible to process two plate portions with identical guides (groovings) to the effect that, upon joining at the joining face (not shown), the plate parts form the flow channels in the coupling element.

[0032] Reference is now made to figures 3a and 3b showing an alternative embodiment of a coupling element for a plate water heater according to the invention and having a structure essentially as described above with reference to figures 2a-2c.

[0033] The coupling element 3 distinguishes itself in being formed of a first portion 3a, in which portion flow channels 21, 22 and couplings 7, 8, 9, 10a for heat-absorbing 7, 8 and heat-emitting liquid 9, 10a are configured, and a second portion 3b that can advantageously be an end plate of a conventional type featuring channel openings configured at the corners of the side face 4.

[0034] Moreover, the coupling element is configured with flow channels 21, 22, 24 extending across a part of the coupling element as open flow channels 21, 22, 24

towards that side face of the coupling element which is configured for being joined with a conventional end plate 3b. The end plate 3b will thus serve as a lid for those of the flow channels that are open. At a side face 4b opposite the end plate 3b, a second end plate 3c is configured, said end plate 3c being configured without couplings for liquid.

Claims

1. A plate water heater (1) comprising a coupling element (3) and a plurality of heat exchanger plates combined to form a plate stack (2a) and configured in such a manner that, between adjoining heat exchanger plates, separate flow passages are formed for conveyance of a heat-emitting liquid and a heat-absorbing liquid, respectively, said coupling element (3) comprising flow channels (21, 22, 23, 24) for conveyance of liquid between the flow passages and the couplings (7, 8, 9, 10), and regulator means (6) for regulating the liquid flow in the heat-emitting-liquid, **characterised in that** the flow channel for supply of heat-emitting liquid (22) and the flow channel for discharge of heat-absorbing liquid (21) are, across a substantial part of the coupling element (3), arranged to adjoin each other; that hereby a heat transmission occurs between heat-emitting liquid and heat-absorbing liquid, the coupling element (3) being configured in such a manner that a heat transmission takes place from the flow channel for supply of heat-emitting liquid (22) to the flow channel for heat-absorbing liquid (21), whereby the liquid allowed to stand in the flow channel for heat-absorbing liquid (21) is heated to a desired temperature by a regulation (change) of the liquid flow of the heat-emitting liquid.

2. A plate water heater according to claim 1, **characterised in that** the flow channels (21, 22, 23, 24) are provided in one plane, or essentially in one plane; and that said plane extends in parallel with or essentially in parallel with the plate stack (2a) of the heat exchanger plates.

3. A plate water heater according to any one of the preceding claims, **characterised in that** the coupling element (3) is configured with one or more couplings (7, 8, 9, 10) at an edge of the coupling element (3).

4. A plate water heater according to any one of the preceding claims, **characterised in that** the coupling element (3) is configured with one or more couplings (7, 8, 9, 10) at a side face (4) of the coupling element (3).

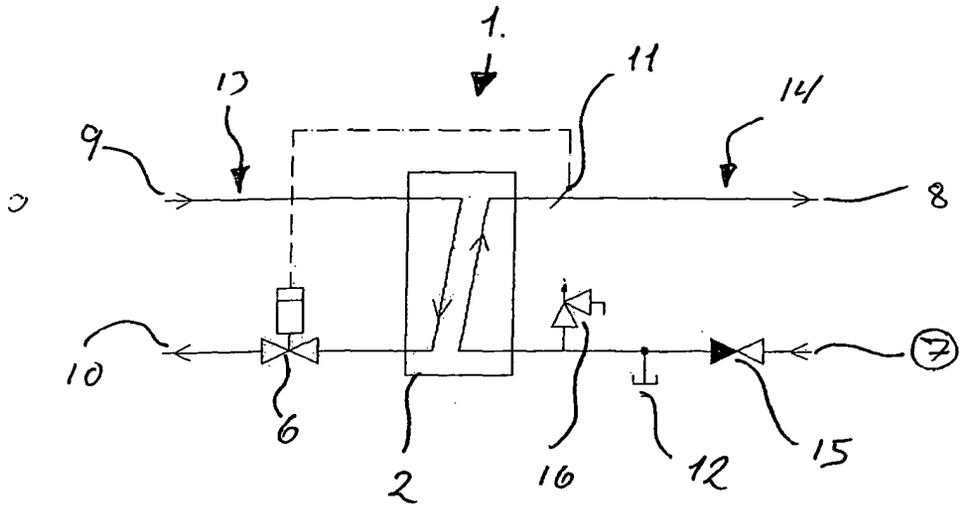
5. A plate water heater according to any one of the preceding claims, **characterised in that**, by the coupling for discharge of heat-emitting liquid (10a), regulator means (6) are configured for regulating the liquid throughput of the heat-emitting liquid; and that the regulator means (6) comprises a sensor (11) for registering the temperature in the flow channel (21) for discharge of the heat-absorbing liquid (8).

6. A plate water heater according to any one of the preceding claims, **characterised in that** the coupling element (3) is formed by joining of two or more plate parts.

7. A plate water heater according to claim 7, **characterised in that** the plate parts are joined at a side face essentially coinciding with a plane in parallel with the heat exchanger plates.

8. Use of a plate water heater (1) for regulating the temperature of a heat-absorbing liquid in an operating context without use of heat-absorbing liquid, wherein said plate water heater (1) comprises a coupling element (3) and a plurality of heat exchanger plates combined to a plate stack (2a) and configured in such manner that, between adjoining heat exchanger plates, separate flow passages are formed for conveying a heat-emitting liquid and a heat-absorbing liquid, respectively, said coupling element (3) comprising flow channels (21, 22, 23, 24) for conveying liquid between the flow passages and the couplings (7, 8, 9, 10) and regulator means (6) for regulating the liquid flow in the heat-emitting liquid, and that the regulator means (6) comprise a sensor (11) for registering the temperature in the flow channel (21) for discharge of the heat-absorbing liquid (8), said coupling element (3) being configured in such a manner that a heat transmission occurs from the flow channel for supply of heat-emitting liquid (22) to the flow channel for heat-absorbing liquid (21), whereby the sensor (11) and the liquid allowed to stand in the flow channel for heat-absorbing liquid (21) is heated to a desired temperature, at which desired temperature the regulator means (6) receives signal from the sensor (1) to shut off the liquid flow of heat-emitting liquid.

9. Use according to claim 8, by which the sensor (11) transmits a signal to the regulator means (6) to open the liquid flow of heat-emitting liquid in the flow channel for heat-emitting liquid (22) when the temperature on the liquid allowed to stand in the flow channel for heat-absorbing liquid (21) has dropped to a lower value.



Figur 1

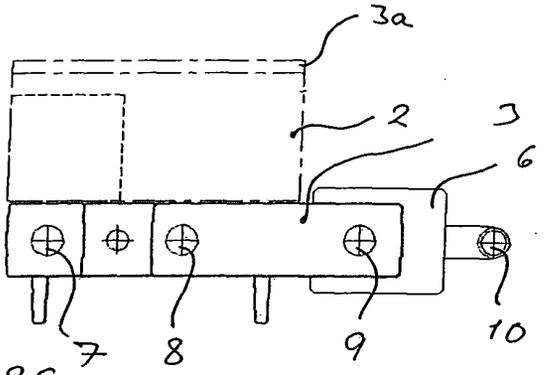


Fig 2C

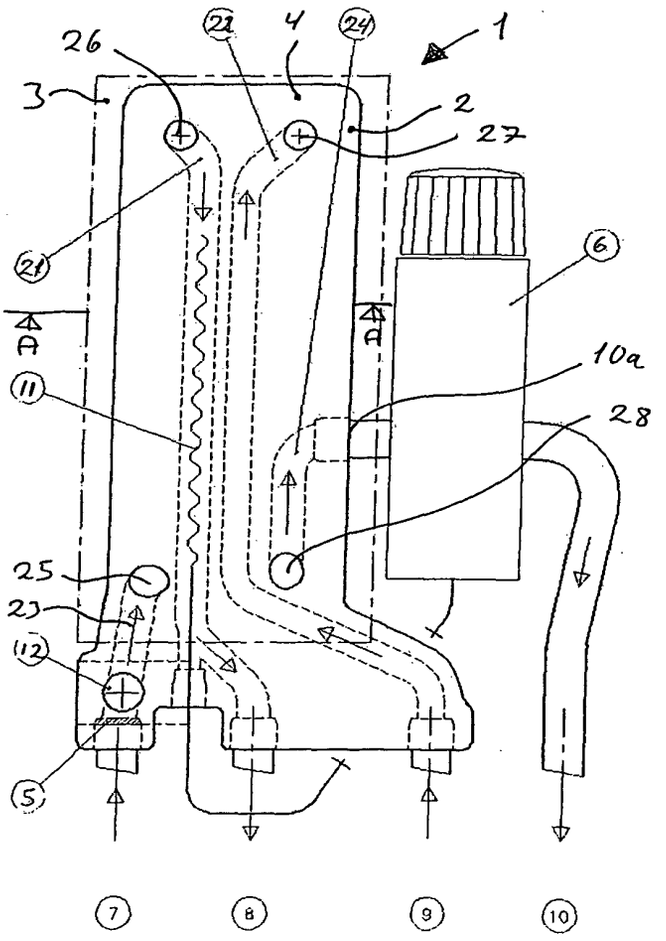


Fig 2a

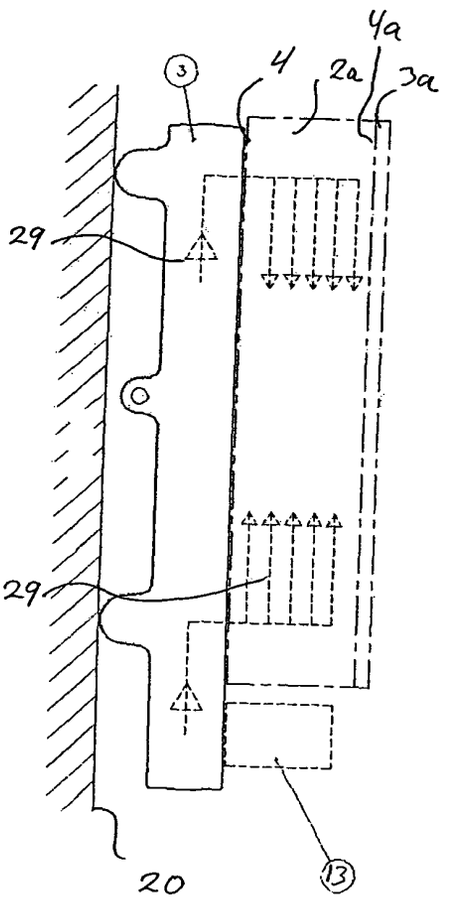


Fig. 2b

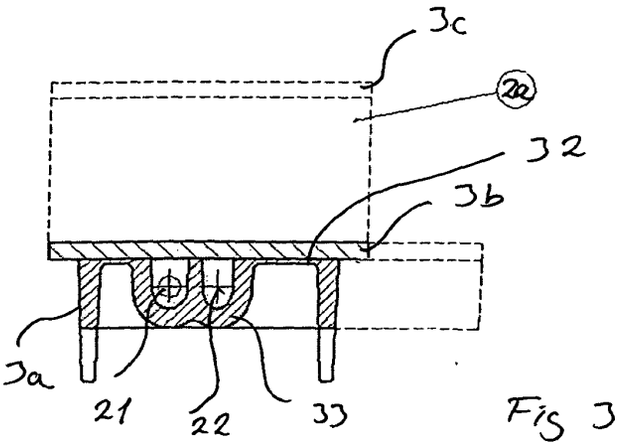


Fig 3b

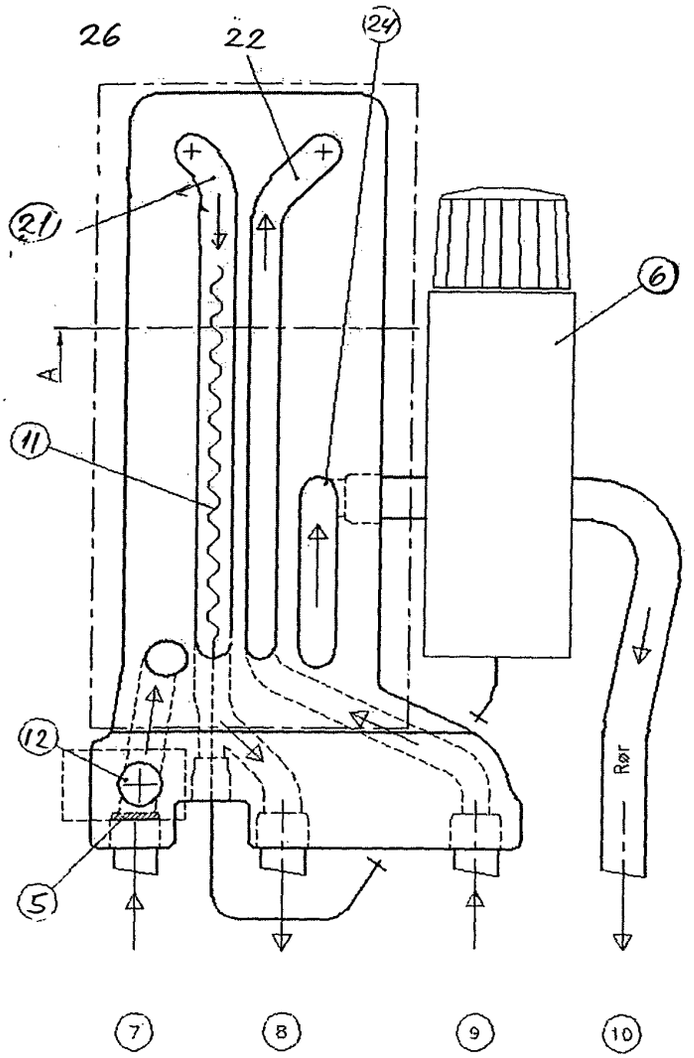


Fig 3a