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(54) **BANK FOR HEATING ELEMENT AND A HEATING ELEMENT COMPRISING SUCH A BANK**

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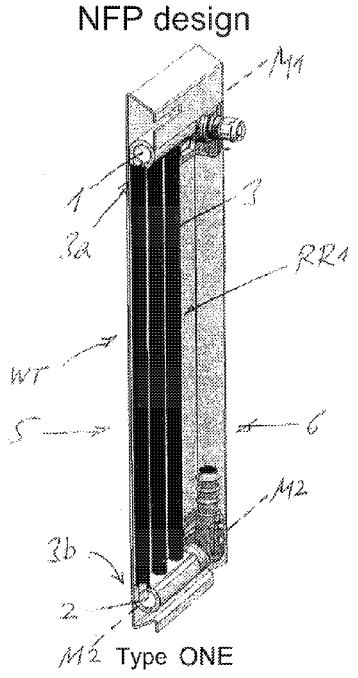
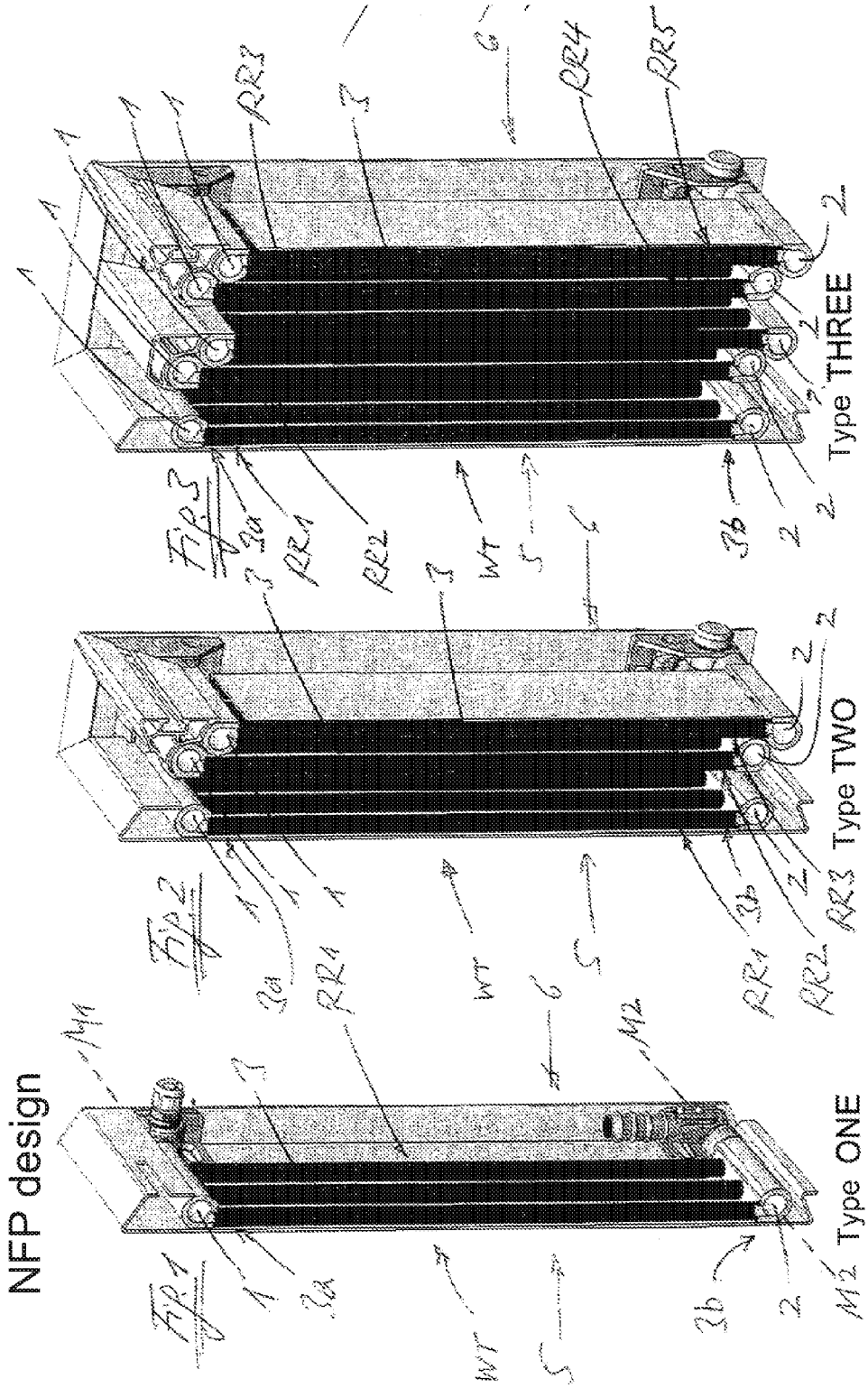
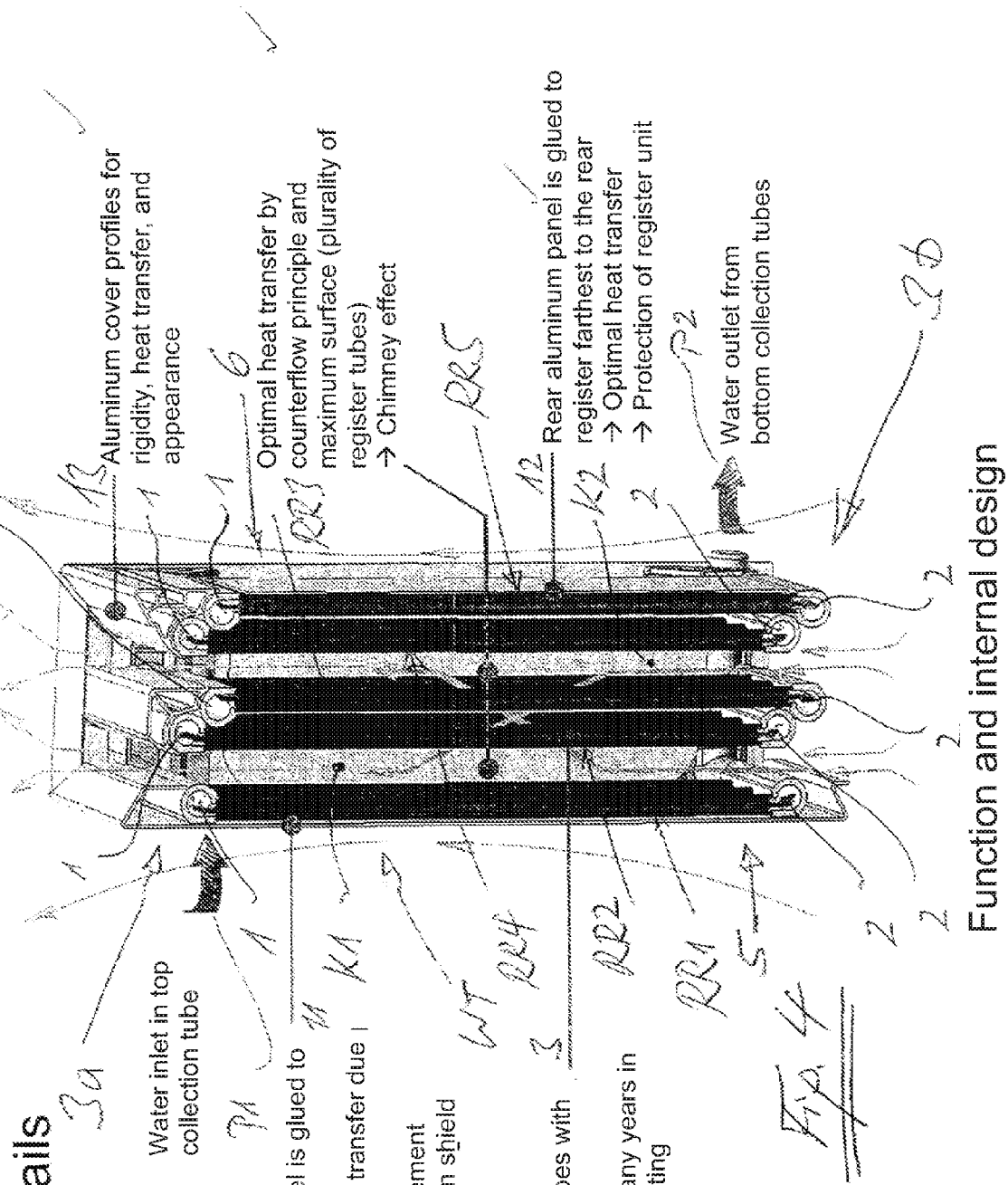
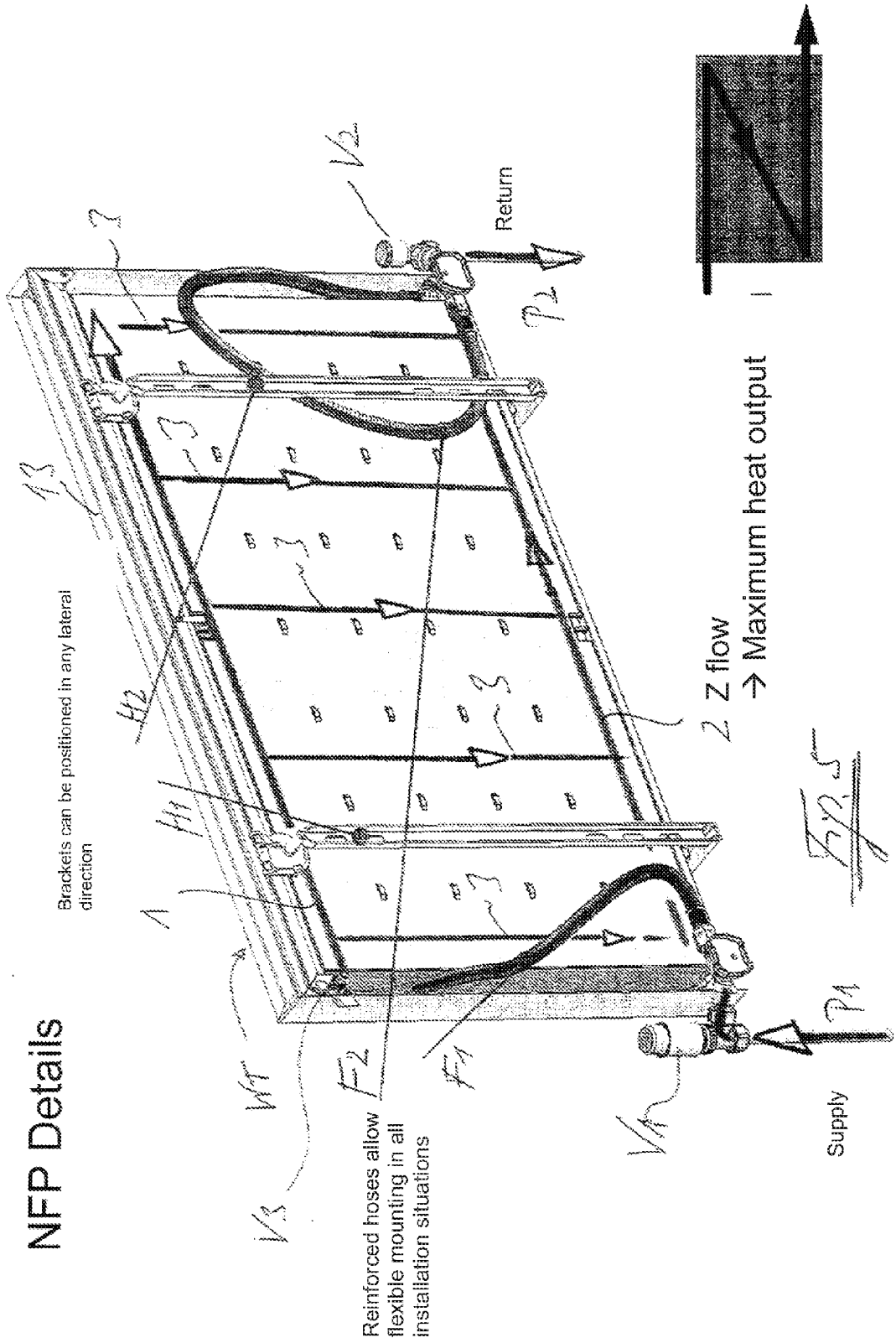
(57) **ABSTRACT**

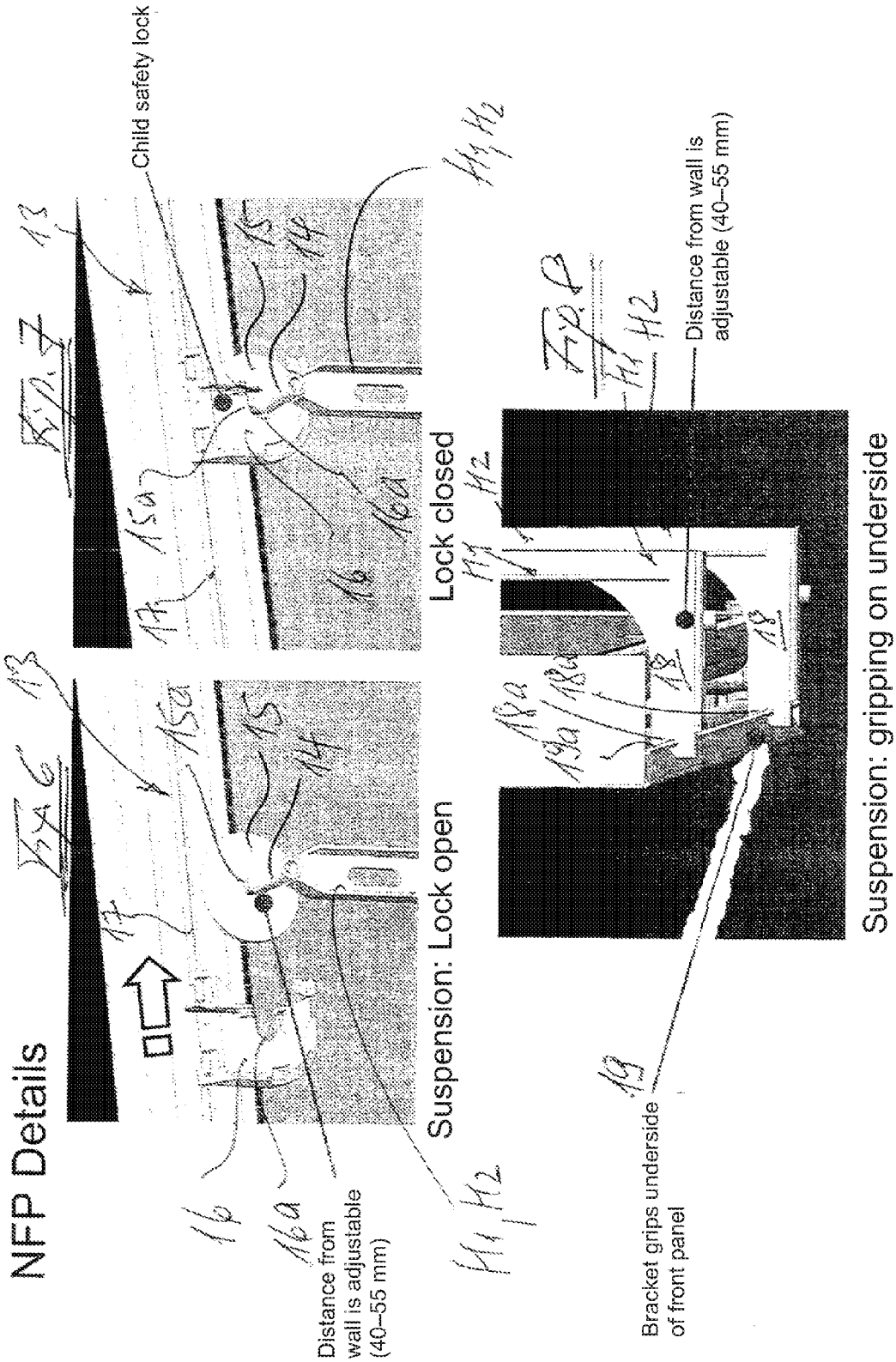
The invention relates to a tube register (RR) for a heat exchanger (WT), in particular a heating element or cooling element, through which a heat transfer fluid may flow, and which has two distributor lines (**1**, **2**), between which a plurality of connecting tubes (**3**) extend which fluidically connect the first distributor line, also referred to as the supply distributor (**1**), to the second distributor line, also referred to as the return distributor (**2**), the tube register having a linear supply distributor (**1**) and a linear return distributor (**2**) running in parallel thereto, between which a plurality of connecting tubes (**3**), situated in a plane, extend, the first ends (**3***a*) of the connecting tubes (**3**) in each case being fluidically connected to the supply distributor (**1**), and the second ends (**3***b*) of the connecting tubes (**3**) in each case being fluidically connected to the return distributor (**2**), characterized in that the connecting sites (P**1**) between the supply distributor (**1**) and the connecting tubes (**3**) are situated eccentrically, relative to the center axis (M**1**) of the supply distributor (**1**), on the supply distributor (**1**), and the connecting sites (P**2**) between the return distributor (**2**) and the connecting tubes (**3**) are situated eccentrically, relative to the center axis (M**2**) of the return distributor (**2**), on the return distributor (**2**).




NFP design
Type ONE
Type TWO
Type THREE


NFP Details
Water inlet in top collection tube
Front steel panel is glued to first register
→ Optimal heat transfer due to gluing
→ Structural element
→ Heat radiation shield
Polybutene tubes with oxygen barrier
→ Used for many years in underfloor heating
Aluminum cover profiles for rigidity, heat transfer, and appearance
Optimal heat transfer by counterflow principle and maximum surface (plurality of register tubes)
→ Chimney effect
Rear aluminum panel is glued to register farthest to the rear
→ Optimal heat transfer
→ Protection of register unit
Water outlet from bottom collection tubes
Function and internal design


NFP Details
Brackets can be positioned in any lateral direction
Reinforced hoses allow flexible mounting in all installation situations
Return
Supply
Z flow
→ Maximum heat output


NFP Details
Fig. 6
Fig. 7
Fig. 8
Child safety lock
Lock closed
Suspension: Lock open
Distance from wall is adjustable (40–55 mm)
Distance from wall is adjustable (40–55 mm)
Bracket grips underside of front panel
Suspension: gripping on underside

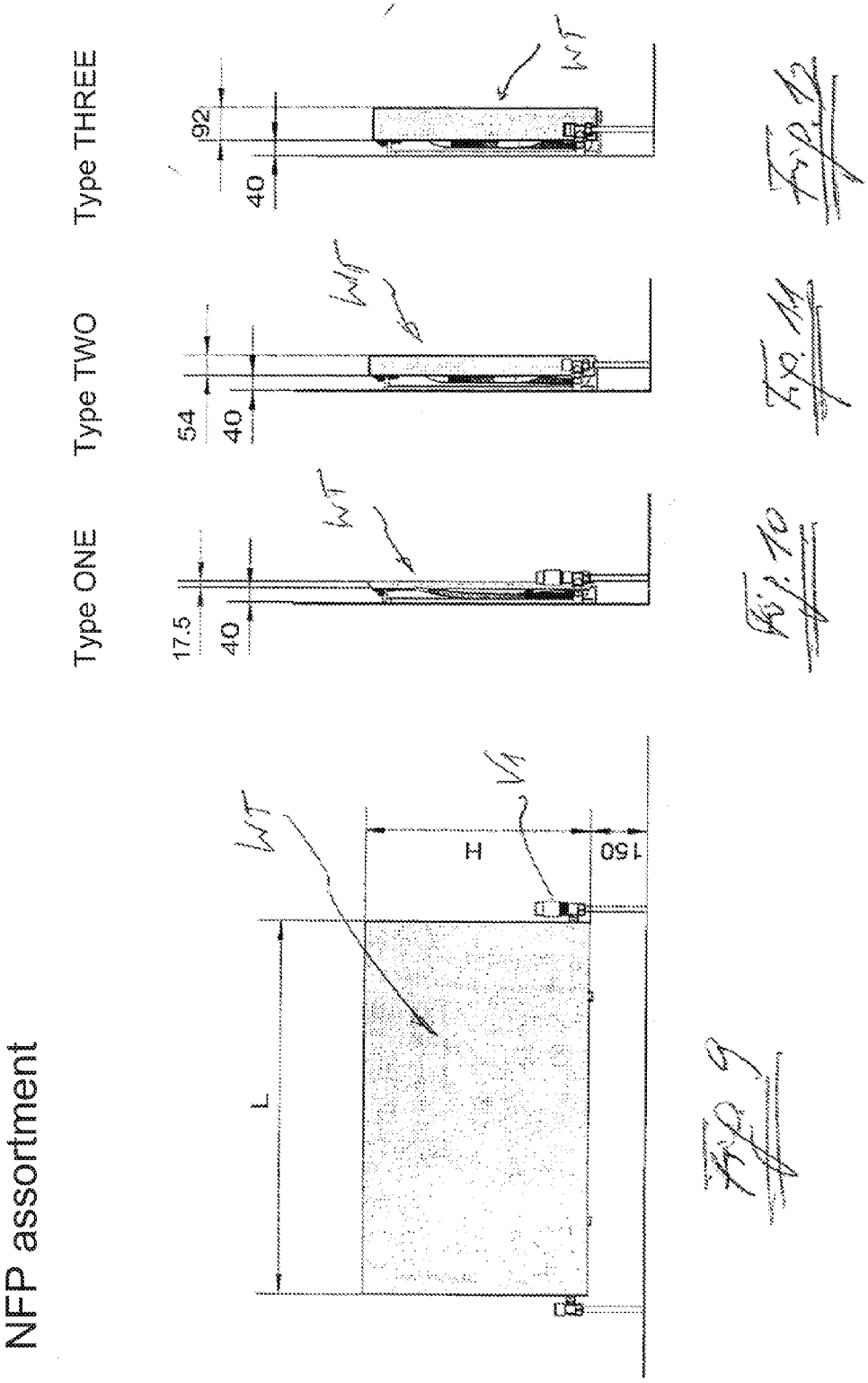
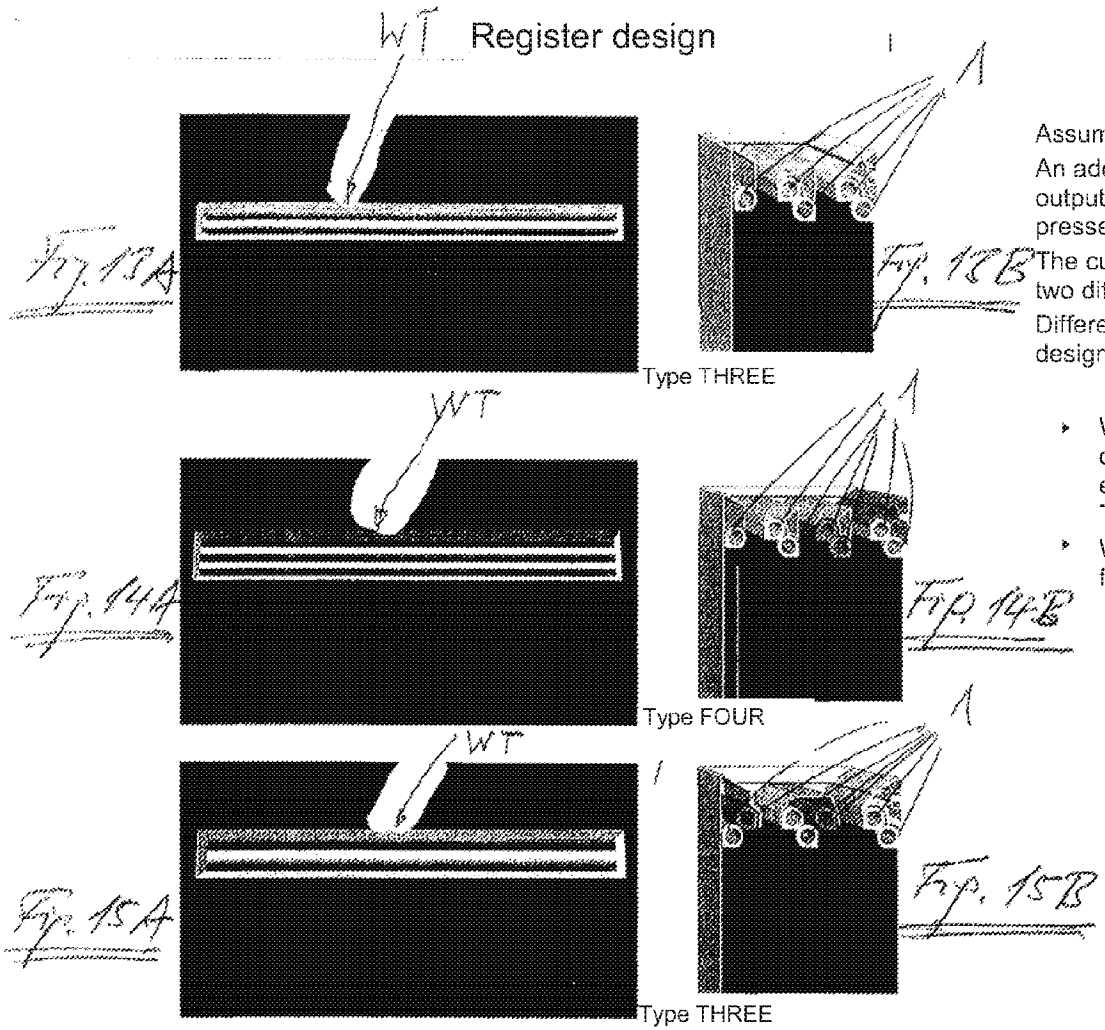


Fig. 10

Fig. 11

Fig. 12

Fig. 9



Assumption:

An additional double register increases the heat output of THREE to a level similar to a Type 33 pressed steel panel.

The current THREE register unit can be expanded in two different ways.

Different appearances are obtained by a different design of the register unit.

- With the design according to the previous design principle, and based on the use of existing parts, a FOUR is formed from the THREE
- With the new design, a THREE+ is formed from the THREE

FOUR | Variant 1

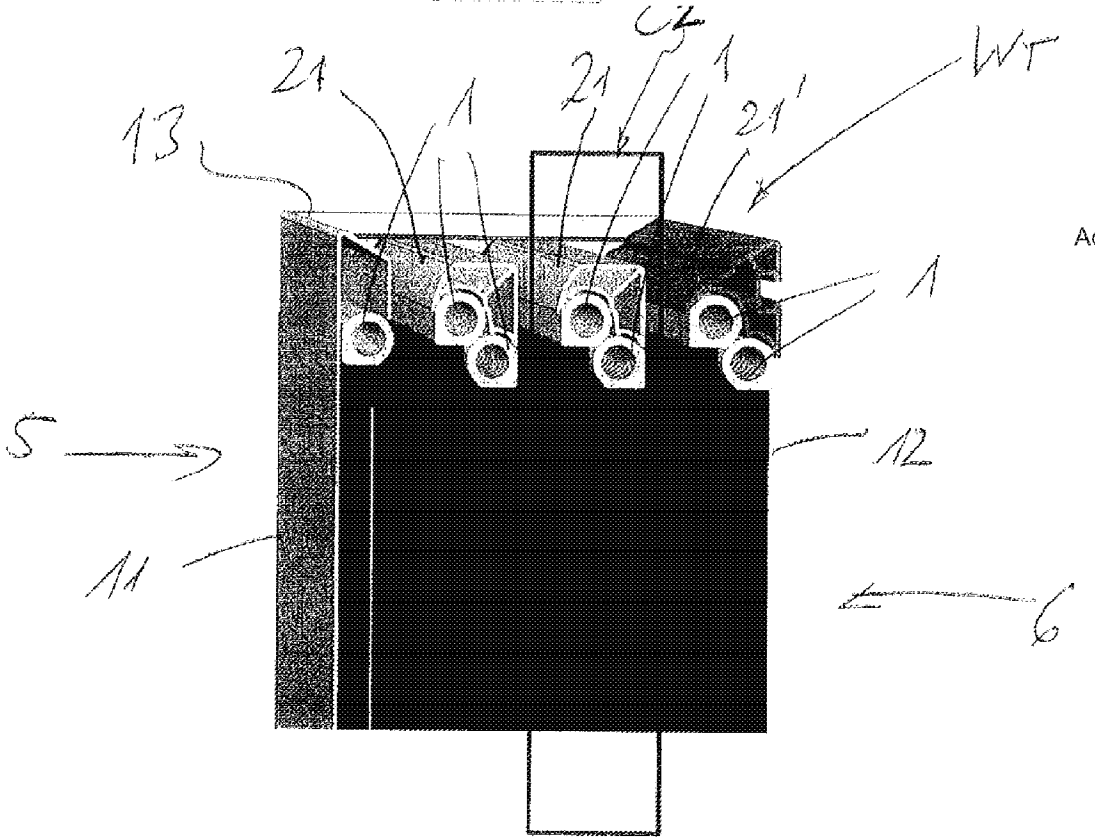


Fig. 16

Adaptation to FOUR

- Using the same design principle, 1 double register is packaged to form a FOUR
- The same cover profiles and registers may be used as for TWO and THREE
- The same register heights as for Type THREE may be used
- Less expense in going from THREE to FOUR
  - Development expense
  - Conversion from THREE to FOUR in production

Comments

- Proportions no longer correspond!
- Electric heater character (grill)
- Overall appearance is more complex

FOUR Variant 1

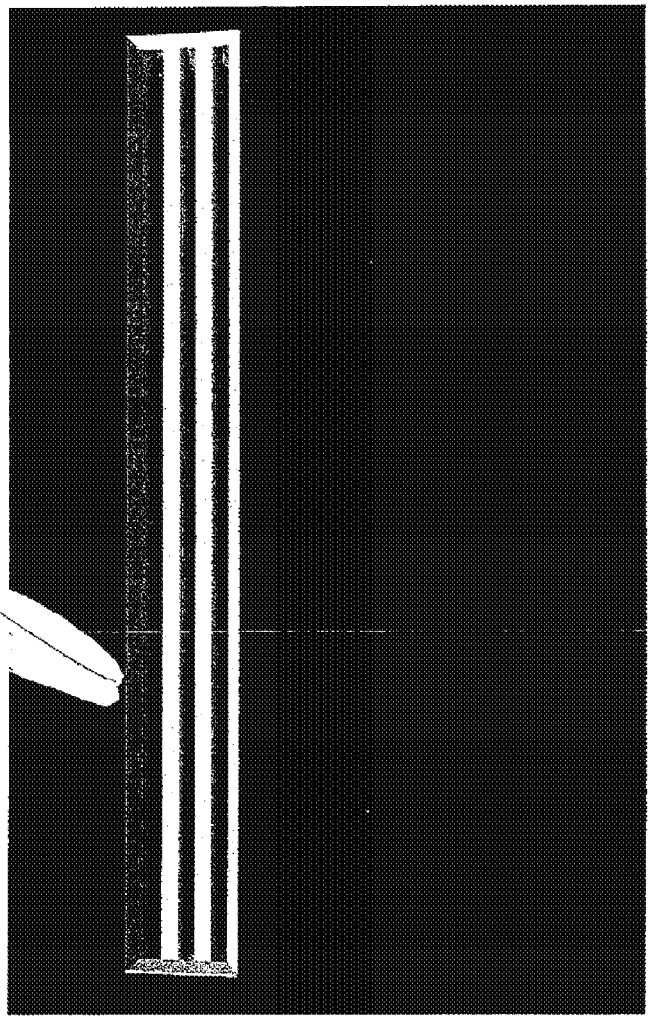


Fig. 1B

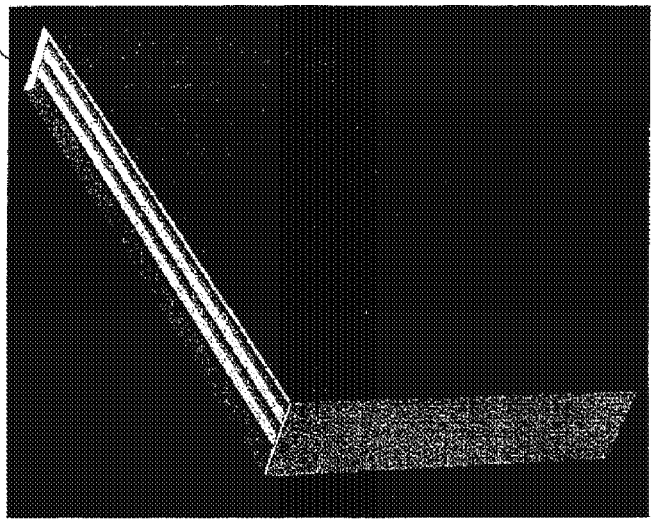
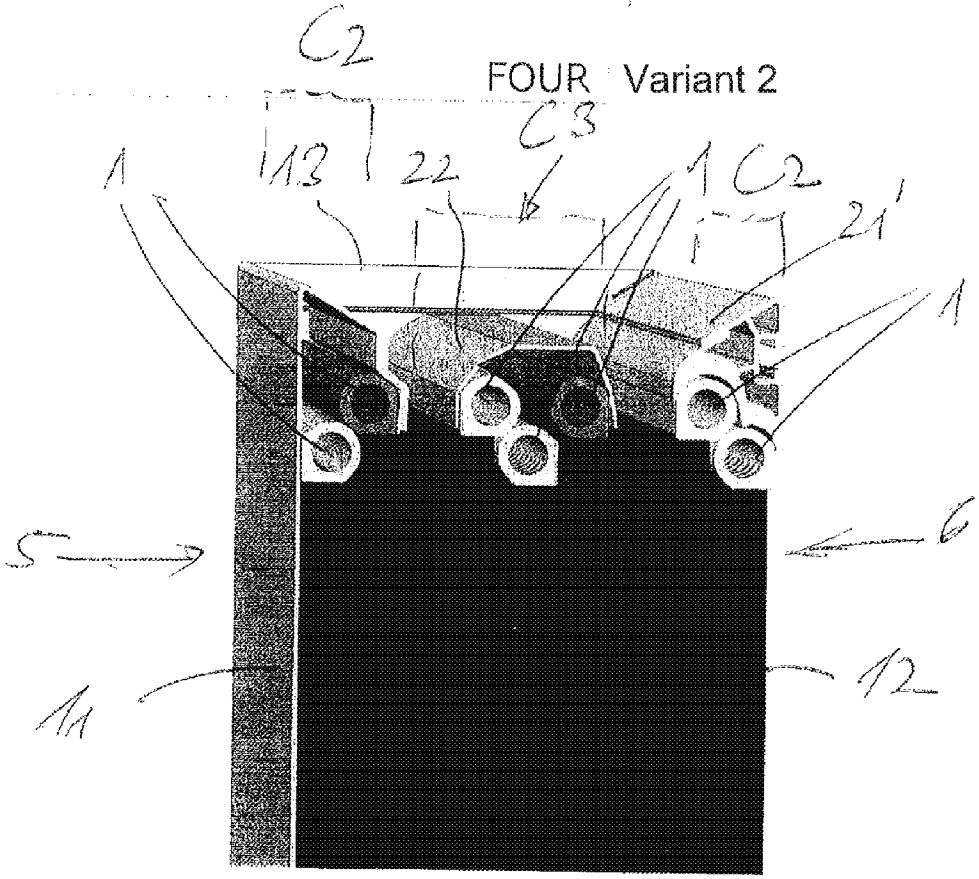


Fig. 1A



Additional register pair is divided

Adaptations of THREE+

- New design of register unit
- Due to the new configuration and the altered proportions, the same profiles as for TWO and THREE cannot be used
- For sufficient convection, the gap size of 12 mm between the registers must be increased to 15--18 mm minimum.
- The heating element panel is adapted to the new proportions (wider outside edges)

Comments

- New cover profiles
- Different register unit design principle

Fig. 19

FOUR | Variant 2

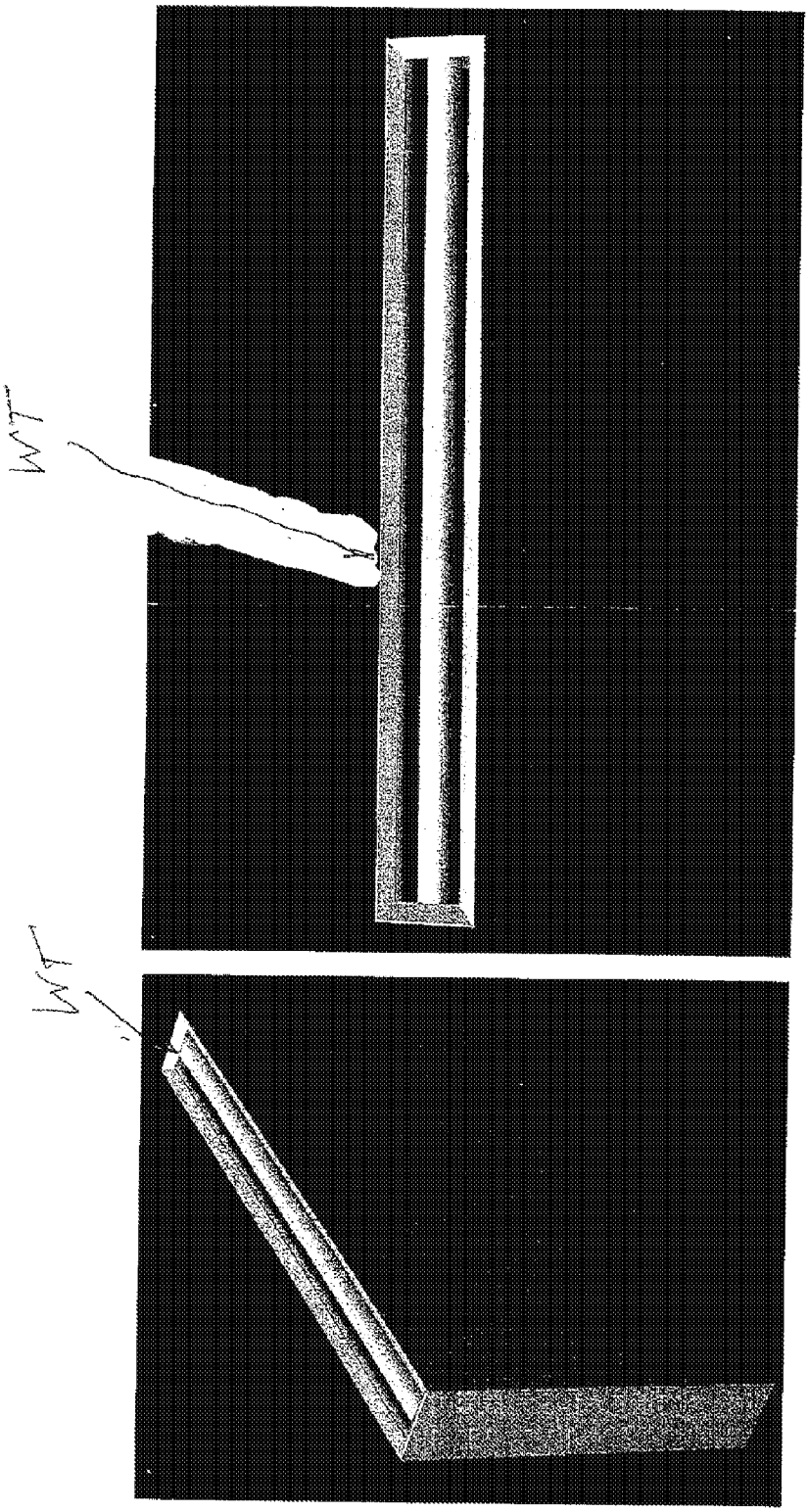
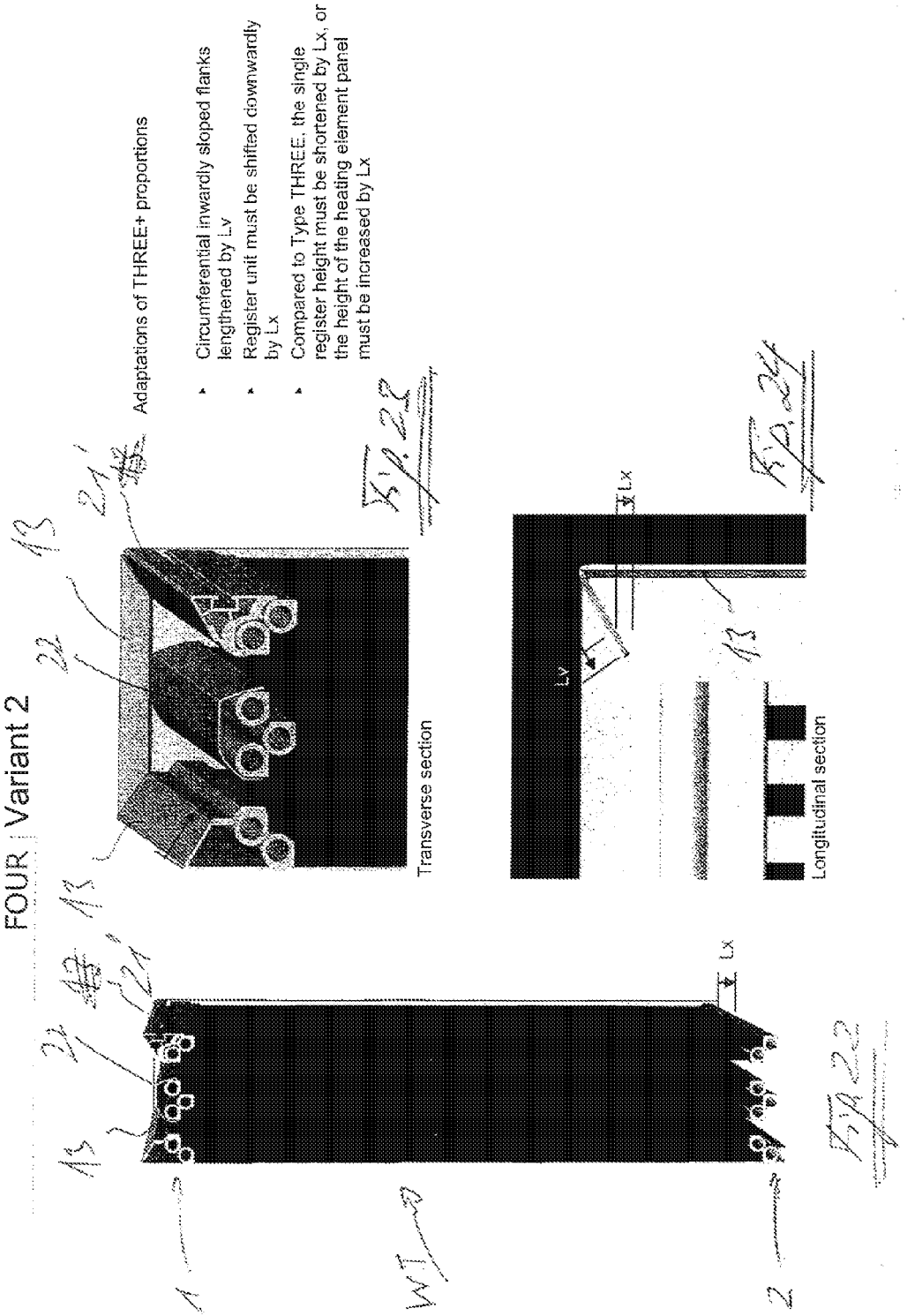
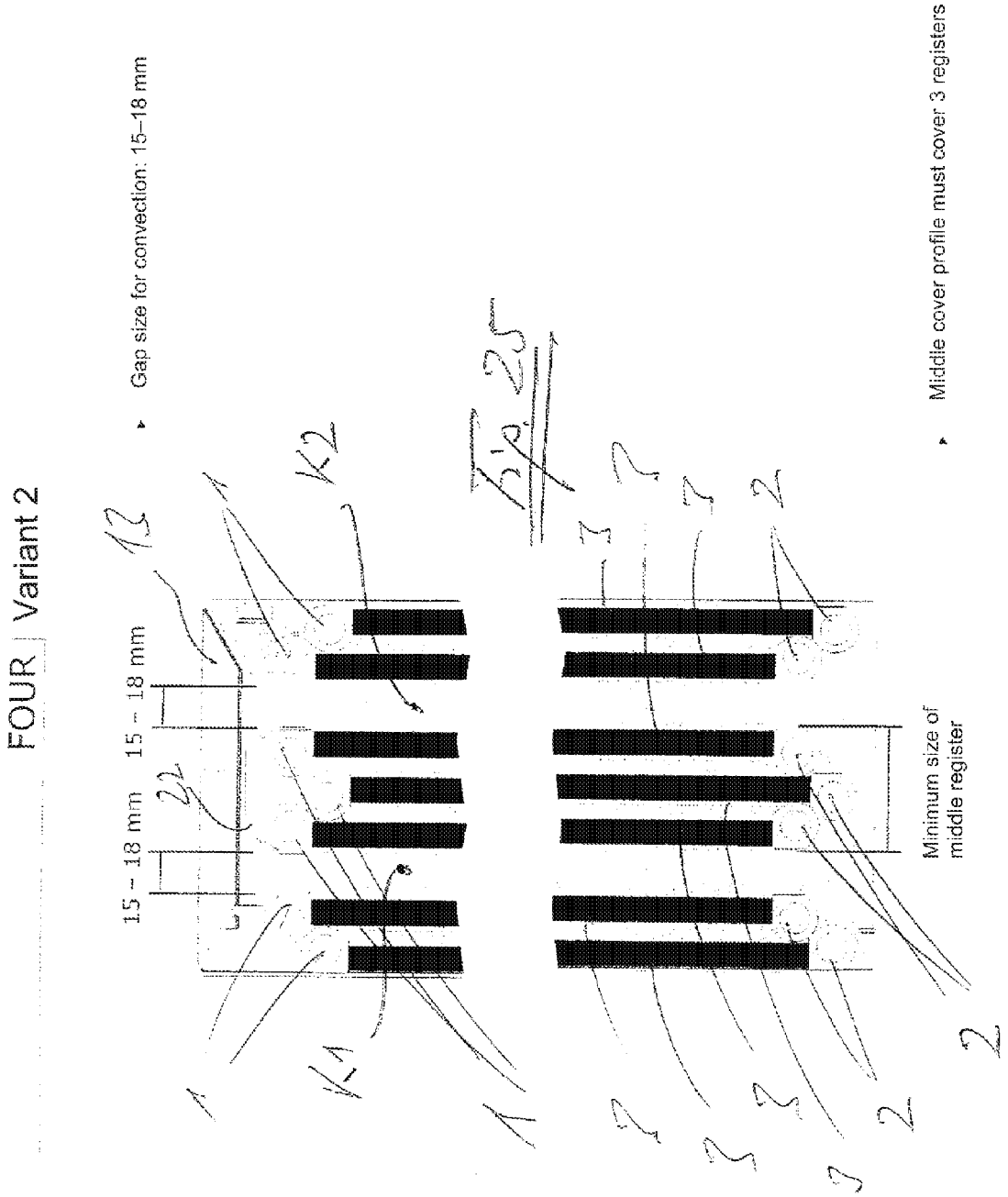


Fig. 21

Fig. 20


FOUR | Variant 2
Adaptations of THREE+ proportions
Circumferential inwardly sloped flanks lengthened by Lv
Register unit must be shifted downwardly by Lx
Compared to Type THREE, the single register height must be shortened by Lx, or the height of the heating element panel must be increased by Lx
Transverse section
Longitudinal section
Lx
Lv


FOUR | Variant 2
Gap size for convection: 15–18 mm
Middle cover profile must cover 3 registers
15 – 18 mm
15 – 18 mm
Minimum size of middle register

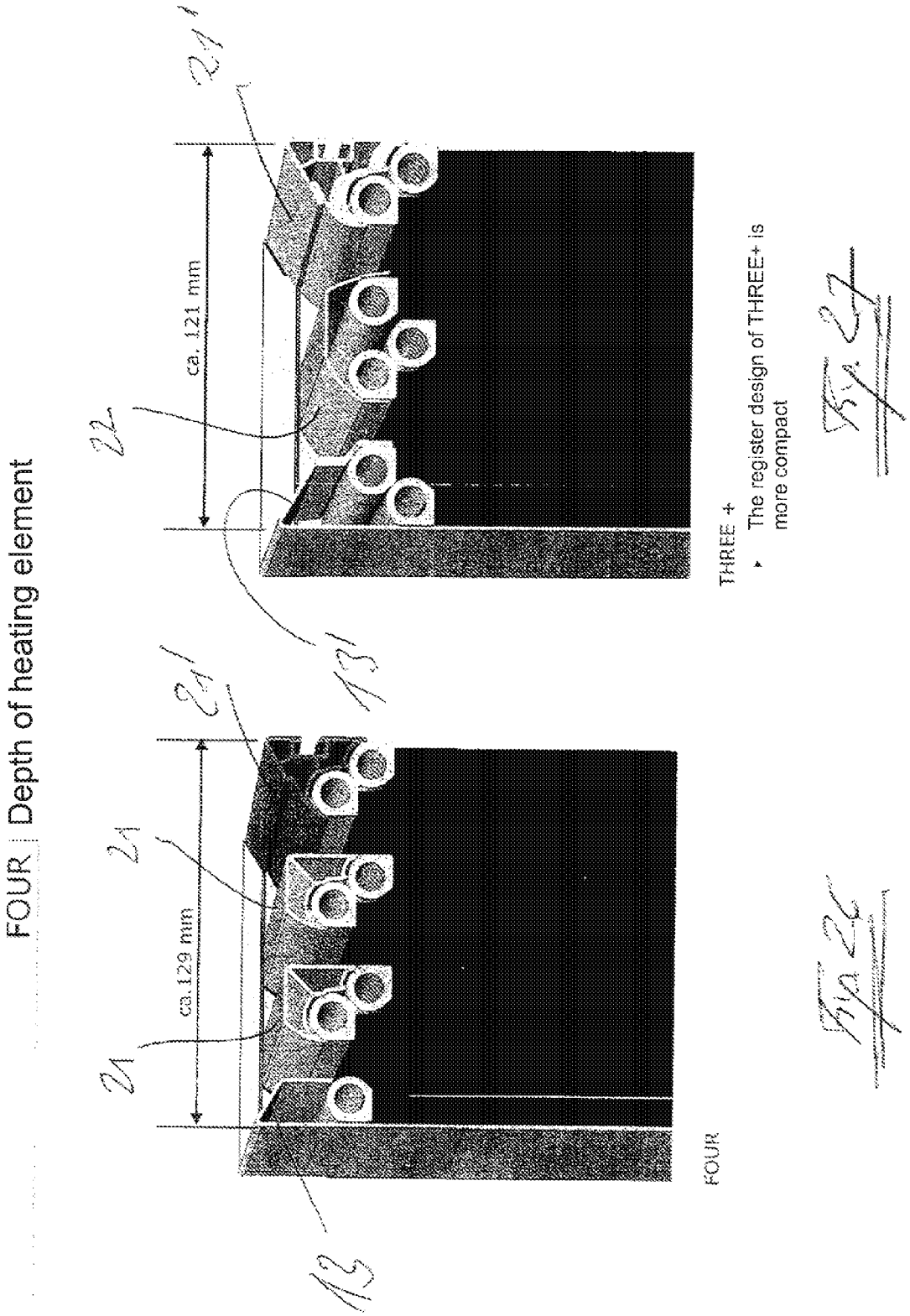
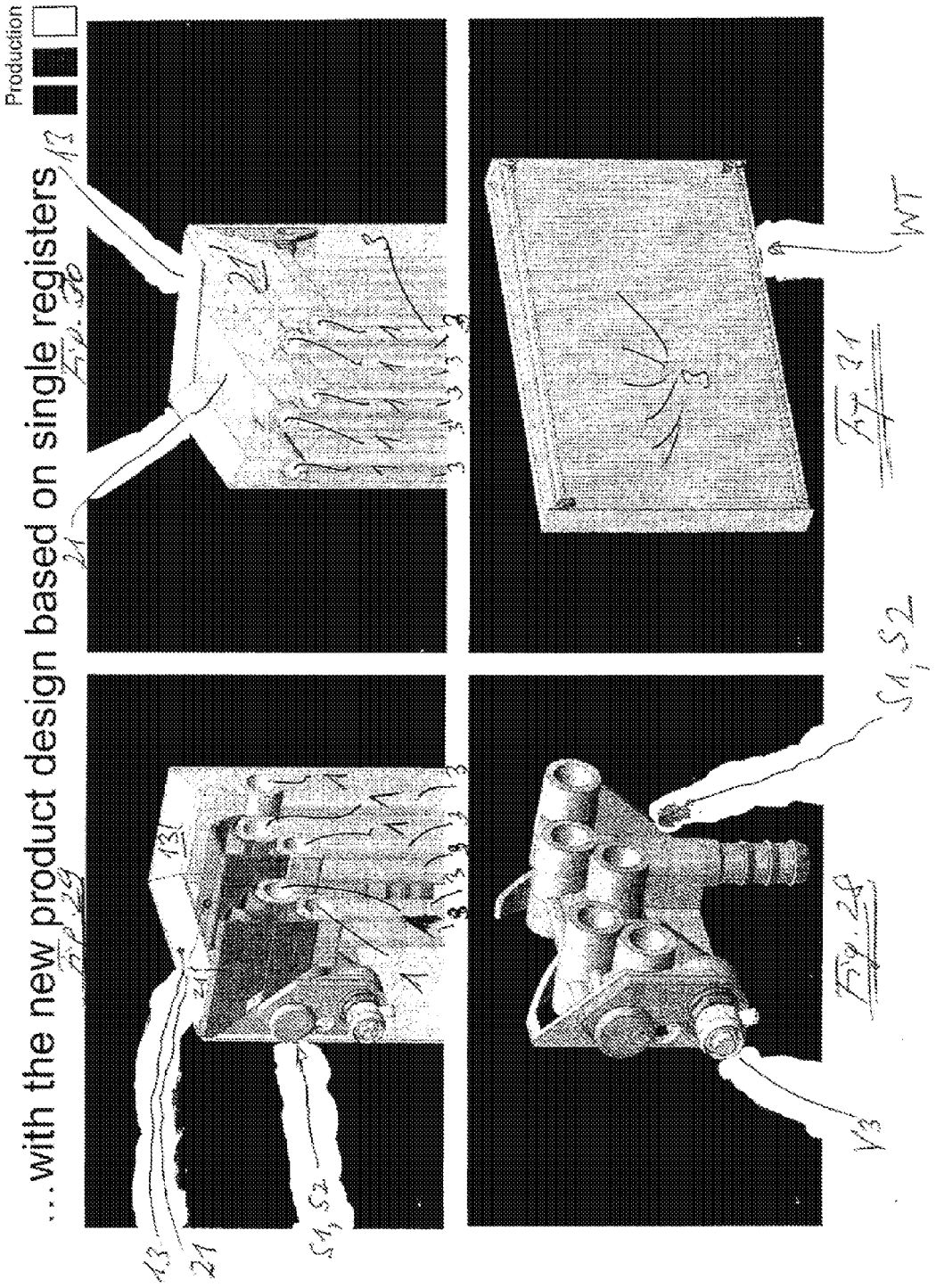
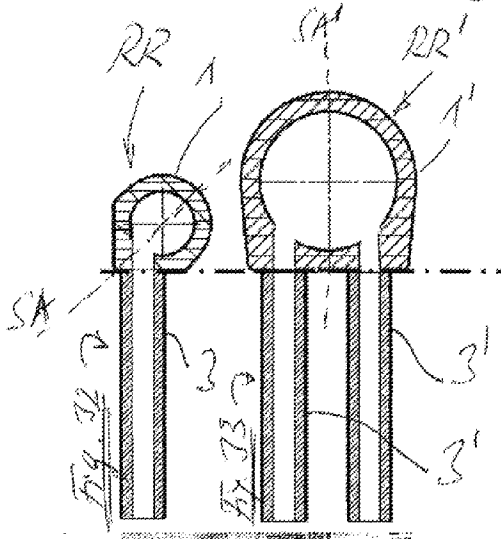

FOUR | Depth of heating element
ca. 129 mm
21
21'
13
FOUR
ca. 121 mm
22
21'
13'
THREE +
The register design of THREE+ is more compact

Fig. 2c

Fig. 2d


Production
...with the new product design based on single registers
13
21
S1, S2
WT
V3

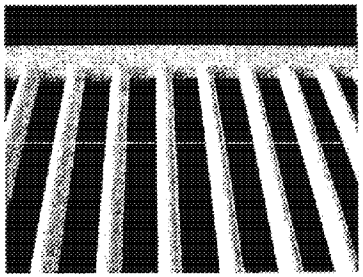
NFP-MMP: welding process (2012-08-21)



Horizontal collector tubes: basically these tubes do not need a diffusion layer because thickness is big enough to avoid diffusion (but technically feasible)

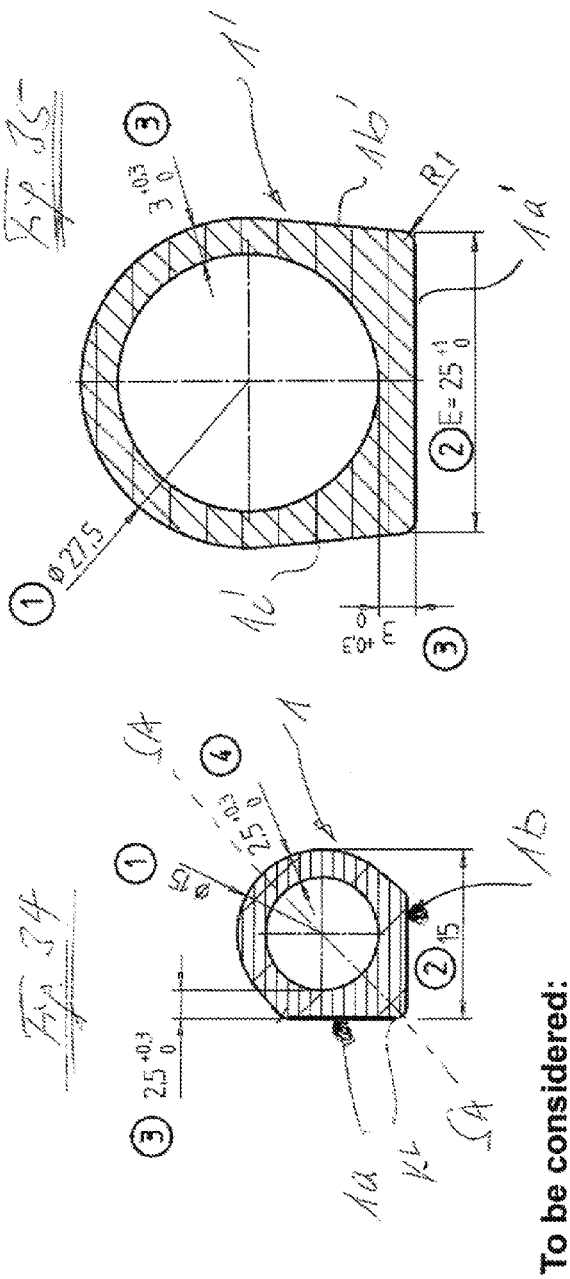
Along this line the heating plate melts the components (approx. 200°C) before the are joined together

Vertical register tubes: these tubes need to have a diffusion layer



2012-08-21: first single layer registers were produced and passed the pressure tests (50+ bars)

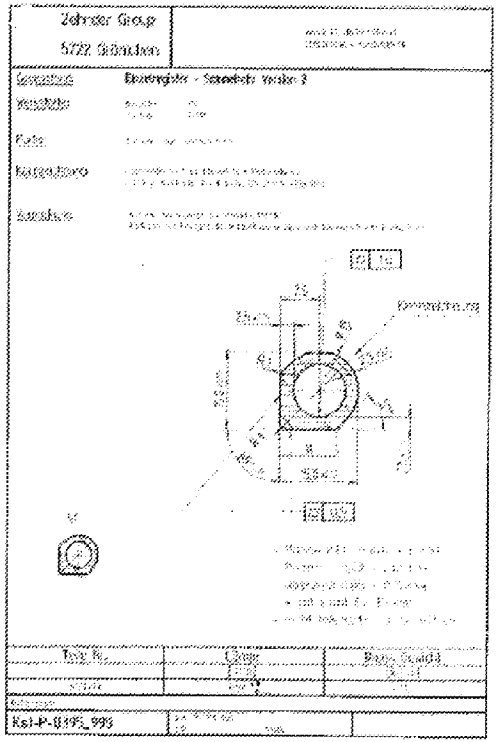
NFP-MMP/collector tubes: geometry & tolerances

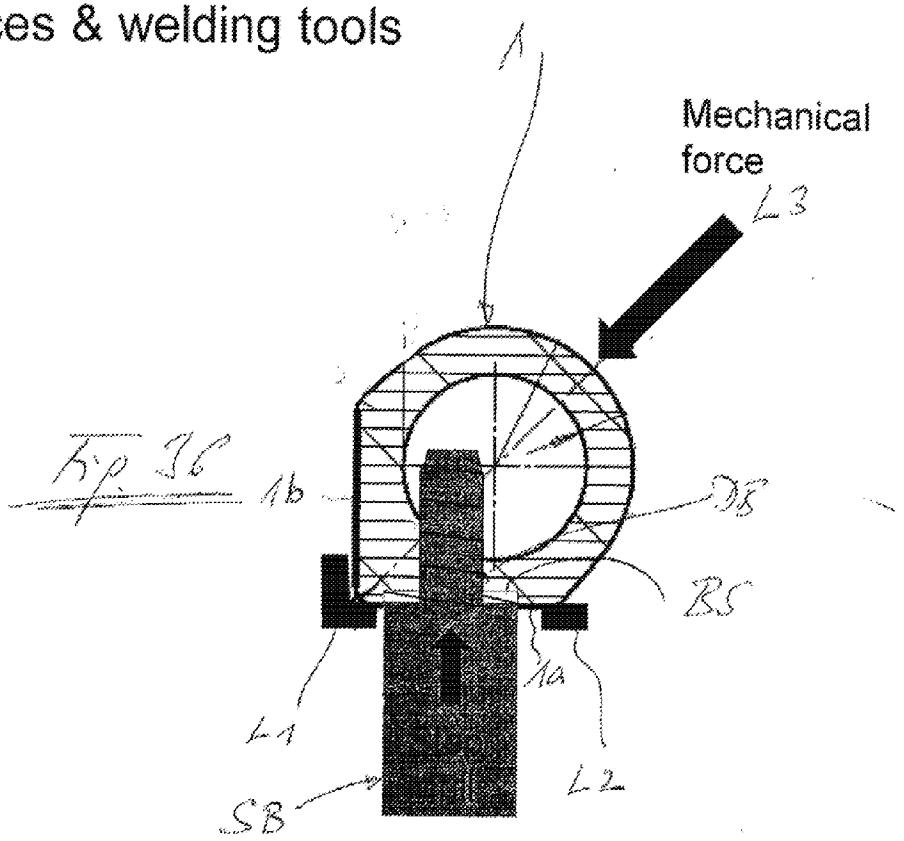


To be considered:

- On the inside we need a round tube geometry → results in "100%" tensile stress (otherwise deformation would be too big under pressure/temperature!)
- Extrusion of not fully round tubes is challenging (tolerances!) → there has to be at least a symmetry line
- Tolerances have to be in the "conventional" range → reasonable production costs

NFP-MMP: new tolerances & welding tools





- Tighter tolerances and new tools will guarantee much higher quality of welding process (t.b.c.) → "ppm level" of car industry

BANK FOR HEATING ELEMENT AND A HEATING ELEMENT COMPRISING SUCH A BANK

[0001] The invention relates to registers for a heating element, and heating elements having such registers.

[0002] There are numerous types of heating elements. A classical heating element contains two distributor lines, between which a plurality of connecting tubes extend which fluidically connect the first distributor line, also referred to as the supply distributor, to the second distributor line, also referred to as the return distributor.

[0003] To increase the specific heat capacity of a heating element, i.e., the thermal output released by radiation and convection to a space per unit area of the front elevation of the heating element, it is known to provide multicolumn heating elements in which multiple registers made up of connecting tubes extend essentially in parallel to one another between the supply distributor and the return distributor.

[0004] On the one hand, the manufacture of multicolumn heating elements of this type is relatively complicated.

[0005] On the other hand, the thickness of such multicolumn heating elements, measured perpendicular to the front elevation, increases with an increasing number of registers (three-column, four-column, five-column, six-column), as the result of which the flat board-like or panel-like character of such high-performance multicolumn heating elements is lost.

[0006] The object of the invention is to allow multicolumn heating elements having the design described at the outset, which on the one hand have a small thickness and still have excellent thermal output, and on the other hand may be cost-effectively manufactured.

[0007] To achieve this object, the invention provides a tube register (RR) for a heat exchanger (WT), in particular a heating element or cooling element, through which a heat transfer fluid may flow, and which has two distributor lines (**1**, **2**), between which a plurality of connecting tubes (**3**) extend which fluidically connect the first distributor line, also referred to as the supply distributor (**1**), to the second distributor line, also referred to as the return distributor (**2**), the tube register having a linear supply distributor (**1**) and a linear return distributor (**2**) running in parallel thereto, between which a plurality of connecting tubes (**3**), situated in a plane, extend, the first ends (**3***a*) of the connecting tubes (**3**) in each case being fluidically connected to the supply distributor (**1**), and the second ends (**3***b*) of the connecting tubes (**3**) in each case being fluidically connected to the return distributor (**2**). According to the invention, the connecting sites (P**1**) between the supply distributor (**1**) and the connecting tubes (**3**) are situated eccentrically, relative to the center axis (M**1**) of the supply distributor (**1**), on the supply distributor (**1**), and the connecting sites (P**2**) between the return distributor (**2**) and the connecting tubes (**3**) are situated eccentrically, relative to the center axis (M**2**) of the return distributor (**2**), on the return distributor (**2**).

[0008] The tube register (RR) according to the invention, in a projection plane orthogonal to the longitudinal axis of the supply distributors and return distributors, has the appearance of a structure having the approximate shape of a rectangular letter C, the projection of the supply distributor (**1**) forming the upper horizontal section of the C, the projection of the return distributor (**2**) forming the lower horizontal section of the C, and the projection of the connecting tubes (**3**) forming the vertical section of the C.

[0009] The tube register according to the invention therefore has only two planes of symmetry. A first plane of symmetry extends orthogonally with respect to the longitudinal axis of the supply distributor (**1**) and orthogonally with respect to the longitudinal axis of the return distributor (**2**). A second plane of symmetry extends orthogonally with respect to the longitudinal axis of the connecting tubes (**3**). The tube register according to the invention is asymmetrical with respect to any third plane which extends in parallel to the longitudinal axes of the supply distributor (**1**), of the return distributor (**2**) and of the connecting tubes (**3**).

[0010] Due to this asymmetry of the tube register (RR) according to the invention, by combining multiple (n) tube registers (RR**1**, RR**2**, . . . , RRn) according to the invention, a wide variety of heat exchangers (WT) according to the invention may be manufactured, each of which has different dimensions and thermal properties with regard to radiation output and convection, depending on the relative configuration of the individual registers (RR**1**, RR**2**, . . . , RRn) with respect to one another.

[0011] In addition, using the tube register (RR) according to the invention as a modular base element, a wide variety of heat exchangers (WT) according to the invention may be cost-effectively manufactured.

[0012] According to one particularly preferred embodiment, the tube register (RR) is made of polymer material.

[0013] As a result, particularly lightweight heat exchangers (WT) according to the invention may be manufactured, which have a very large ratio of the thermal output (radiation+convection) of the heat exchanger to the mass of the heat exchanger.

[0014] The supply distributor (**1**) and the return distributor (**2**) may be made of a first polymer material, while the connecting tubes (**3**) may be made of a second polymer material. Alternatively, the supply distributor (**1**) and the return distributor (**2**) as well as the connecting tubes (**3**) may be made of the same polymer material.

[0015] The supply distributor (**1**) and the return distributor (**2**) as well as the connecting tubes (**3**) are preferably tubes that are manufactured by extrusion, and welded or glued to one another at the connecting sites (P**1**, P**2**). In the case of a weld connection, ultrasonic welding is preferred.

[0016] Moreover, the invention provides a heat exchanger (WT), in particular a heating element or cooling element, which has multiple adjacently situated tube registers (RR**1**, RR**2**, . . . , RRn) according to one of the preceding paragraphs.

[0017] Due to the asymmetry of the tube registers (RR**1**, RR**2**, . . . , RRn) according to the invention, the combination of multiple (n) such tube registers to form a heat exchanger (WT) allows a wide variety of heat exchangers (WT) according to the invention, which have different dimensions and thermal properties with regard to radiation output and convection, depending on the relative configuration of the individual registers (RR**1**, RR**2**, . . . , RRn) with respect to one another. This wide variety of heat exchangers (WT) according to the invention may therefore be cost-effectively manufactured.

[0018] In the heat exchanger (WT) according to the invention, the adjacently situated fluid inlets of the adjacently situated supply distributors (**1**) are preferably fluidically connected to one another by means of a supply collection member (S**1**) which establishes a fluid connection to the supply line connection (A**1**) of the heat exchanger (WT), and

the adjacently situated fluid outlets of the adjacently situated return distributors (**2**) are fluidically connected to one another by means of a return collection member (S**2**) which establishes a fluid connection to the return line connection (A**2**) of the heat exchanger (WT).

[0019] The supply collection member (S**1**) and the return collection member (S**2**) are preferably made of a polymer material, and are preferably manufactured by injection molding.

[0020] The asymmetry of the tube registers (RR**1**, RR**2**, . . . , RRn) according to the invention and the multiple options for arranging these tube registers, which always have identical shapes, relative to one another as inexpensive base elements are a first factor which contributes toward achieving the object according to the invention.

[0021] The diversity of the heat exchanger variants according to the invention is made possible by a corresponding diversity of collection members (**1**, **2**). Due to the above-described symmetries of each individual tube register (RR) and the corresponding symmetries of any tube register combinations, and due to the connection of the supply line at the top left and the connection of the return line at the bottom right, the configurations of the adjacently situated fluid inlets of the adjacently situated supply distributors (**1**) are point-symmetrical with respect to the configurations of the adjacently situated fluid outlets of the adjacently situated return distributors (**2**).

[0022] The supply collection member (**1**) and the return collection member (**2**) may thus have identical shapes. This is a second factor which contributes toward achieving the object according to the invention.

[0023] As a result, assembling a heat exchanger according to the invention only requires identical tube registers according to the invention in the required number, and two likewise identical collection members for combining the supply distributors and the return distributors. On account of their compact dimensions, the collection members may be cost-effectively manufactured by injection molding.

[0024] The supply distributors (**1**) are preferably glued or welded to the supply collection member (S**1**) in the area of their fluid connection to same, and the return distributors (**2**) are preferably glued or welded to the return collection member (S**2**) in the area of their fluid connection to same.

[0025] The heat exchanger (WT) may have a plate-like cover element, which is preferably made of a metal mesh and/or a metal sheet, at least on one of its large surfaces i.e., on its front surface (**5**) and/or on its rear surface (**6**).

[0026] This contributes to homogenization of the surface temperature of the heat exchanger, which is operated as a wall heating element, for example, and to an intensified chimney effect in its interior.

[0027] Further advantages, features, and possible applications of the invention result from the following description of exemplary embodiments of the invention, which are not to be construed as limiting, with reference to the drawings, which show the following:

[0028] FIG. **1** shows a section of a first exemplary embodiment of a heating element according to the invention containing a single tube register according to the invention, in a sectional view;

[0029] FIG. **2** shows a section of a second exemplary embodiment of a heating element according to the invention containing three tube registers according to the invention, in a sectional view;

[0030] FIG. **3** shows a section of a third exemplary embodiment of a heating element according to the invention containing five tube registers according to the invention, in a sectional view;

[0031] FIG. **4** shows the section of the heating element according to the invention from FIG. **3**, with explanations of the function and the internal design of the heating element;

[0032] FIG. **5** shows a heating element according to the invention in a perspective view from its rear side, together with two brackets;

[0033] FIG. **6** shows an enlarged detail of the upper area of a bracket with an open lock;

[0034] FIG. **7** shows the enlarged detail of the upper area of the bracket with a closed lock;

[0035] FIG. **8** shows an enlarged detail of the lower area of the bracket with an engaged suspension;

[0036] FIG. **9** shows the heating element depicted in FIGS. **1**, **2**, and **3** in the installed state, in its front elevation;

[0037] FIG. **10** shows the heating element depicted in FIG. **1**, in a side view;

[0038] FIG. **11** shows the heating element depicted in FIG. **2**, in a side view;

[0039] FIG. **12** shows the heating element depicted in FIG. **3**, in a side view;

[0040] FIG. **13**A shows the third exemplary embodiment of a heating element according to the invention with cladding, in a perspective view;

[0041] FIG. **13**B shows the section of the third exemplary embodiment of a heating element according to the invention, in a sectional view;

[0042] FIG. **14**A shows a fourth exemplary embodiment of a heating element according to the invention containing seven tube registers with cladding, in a perspective view;

[0043] FIG. **14**B shows the section of the fourth exemplary embodiment of a heating element according to the invention, in a sectional view;

[0044] FIG. **15**A shows a fifth exemplary embodiment of a heating element according to the invention, likewise containing seven tube registers with cladding, in a perspective view;

[0045] FIG. **15**B shows the section of the fifth exemplary embodiment of a heating element according to the invention, in a sectional view;

[0046] FIG. **16** shows an enlarged illustration of the fourth exemplary embodiment of a heating element according to the invention shown in FIG. **14**B;

[0047] FIG. **17** shows a perspective view of the fourth exemplary embodiment;

[0048] FIG. **18** shows another perspective view of the fourth exemplary embodiment;

[0049] FIG. **19** shows an enlarged illustration of the fifth exemplary embodiment of a heating element according to the invention shown in FIG. **15**B;

[0050] FIG. **20** shows a perspective view of the fifth exemplary embodiment;

[0051] FIG. **21** shows another perspective view of the fifth exemplary embodiment;

[0052] FIG. **22** shows a section of the fifth exemplary embodiment of a heating element according to the invention which extends over the entire installation height, in a sectional view;

[0053] FIG. **23** shows an enlarged section of the upper area of the fifth exemplary embodiment in a sectional view, the section plane extending transversely with respect to the upper distributors;

[0054] FIG. **24** shows an enlarged section of the upper area of the fifth exemplary embodiment in a sectional view, the section plane extending along the upper distributors;

[0055] FIG. **25** shows a sectional view transverse to the supply and return distributors of the fifth exemplary embodiment, with dimension data;

[0056] FIG. **26** shows a sectional view transverse to the supply and return distributors of the fourth exemplary embodiment, with dimension data;

[0057] FIG. **27** shows a sectional view transverse to the supply and return distributors of the fifth exemplary embodiment, with additional dimension data;

[0058] FIG. **28** shows a perspective view of a supply collection member or return collection member;

[0059] FIG. **29** shows a perspective view of a supply collection member in the installed state;

[0060] FIG. **30** shows another perspective view of the supply collection member in the installed state;

[0061] FIG. **31** shows a rear view of a heating element according to the invention, without the rear panel;

[0062] FIG. **32** shows a sectional view transverse to the supply distributor and along a connecting tube of a first embodiment of the tube register according to the invention;

[0063] FIG. **33** shows a sectional view transverse to the supply distributor and along connecting tubes of a second embodiment of the tube register according to the invention;

[0064] FIG. **34** shows an enlarged sectional view transverse to the supply distributor of the first embodiment of the tube register according to the invention;

[0065] FIG. **35** shows an enlarged sectional view transverse to the supply distributor of the second embodiment of the tube register according to the invention; and

[0066] FIG. **36** shows an enlarged sectional view transverse to the supply distributor of the first embodiment of the tube register according to the invention, during a method step for its manufacture.

[0067] FIG. **1** shows a section of a first exemplary embodiment (Type ONE) of a heating element WT according to the invention in a sectional view, containing a single tube register RR**1** according to the invention. A supply distributor **1** at the upper end of the tube register RR**1** and a return distributor **2** at the lower end of the tube register RR**1** are apparent. Numerous connecting tubes **3** extend in parallel to one another between the supply distributor **1** and the return distributor **2**. The tube register RR**1** forms a heat exchanger WT, in particular a heating element or cooling element, through which a heat transfer fluid may flow. The connecting tubes **3** fluidically connect the supply distributor **1** to the return distributor **2**. The tube register RR**1** has the linear supply distributor **1** and the linear return distributor **2** running in parallel thereto, between which the plurality of connecting tubes **3**, situated in a plane, extend, the first ends **3***a* of the connecting tubes **3** in each case being fluidically connected to the supply distributor **1**, and the second ends **3***b* of the connecting tubes **3** in each case being fluidically connected to the return distributor **2**. The connecting sites between the supply distributor **1** and the connecting tubes **3** are situated eccentrically, relative to the center axis M**1** of the supply distributor **1**, on the supply distributor **1**, and the connecting sites between the return distributor **2** and the connecting tubes **3** are situated eccentrically, relative to the center axis M**2** of the return distributor **2**, on the return distributor **2**. A front side **5** of the heat exchanger WT is shown at the left in FIG. **1**, and a rear side **6** of the heat exchanger WT is shown at the right in FIG. **1**.

[0068] FIG. **2** shows a section of a second exemplary embodiment (Type TWO) of a heating element WT according to the invention in a sectional view, containing three tube registers RR**1**, RR**2**, RR**3** according to the invention. Each of the tube registers RR**1**, RR**2**, RR**3** is identical to the tube register RR**1**. A supply distributor **1** at the upper end of each tube register RR**1**, RR**2**, RR**3** and a return distributor **2** at the lower end of each tube register RR**1**, RR**2**, RR**3** are apparent. Numerous connecting tubes **3** in each case extend in parallel to one another between the supply distributor **1** and the return distributor **2**. The tube registers RR**1**, RR**2**, RR**3** each form a heat exchanger, in particular a heating element or cooling element, through which a heat transfer fluid may flow.

[0069] A space is present between the first tube register R**1** and the register unit RR**2**-RR**3** formed from the second and the third tube registers RR**2**, RR**3**, and forms a vertical convection channel for air which is heated or cooled between the registers RR**1**, RR**2**, RR**3**.

[0070] FIG. **3** shows a section of a third exemplary embodiment (Type THREE) of a heating element WT according to the invention in a sectional view, containing five tube registers RR**1**, RR**2**, RR**3**, RR**4**, RR**5** according to the invention. Each of the tube registers RR**1**, RR**2**, RR**3**, RR**4**, RR**5** is identical to the tube register RR**1**. A supply distributor **1** at the upper end of each tube register RR**1**. RR**2**, RR**3**, RR**4**, RR**5** and a return distributor **2** at the lower end of each tube register RR**1**, RR**2**, RR**3**, RR**4**, RR**5** are apparent. Numerous connecting tubes **3** extend in parallel to one another between the supply distributor **1** and the return distributor **2**. The tube registers RR**1**, RR**2**, RR**3**, RR**4**, RR**5** each form a heat exchanger WT, in particular a heating element or cooling element, through which a heat transfer fluid may flow.

[0071] A first space is present between the first tube register RR**1** and the register unit RR**2**-RR**3** formed from the second and the third tube registers RR**2**, RR**3**, and forms a vertical convection channel for air which is heated or cooled between the registers RR**1**, RR**2**, RR**3**.

[0072] A second space is present between the first register unit RR**2**-RR**3** and the second register unit RR**4**-RR**5** formed from the fourth and fifth tube registers RR**4**, RR**5**, and forms a second vertical convection channel for air which is heated or cooled between the registers RR**1**, RR**2**, RR**3**, RR**4**, RR**5**.

[0073] FIG. **4** shows the section of the heating element or cooling element according to the invention from FIG. **3**, with explanations of the function and the internal design of the heating element. Identical or similar elements in FIGS. **3** and **4** are denoted by the same reference numerals. The arrow P**1** indicates the location at which the supply line enters the heating element. The arrow P**2** indicates the location at which the return line exits the heating element. A cover profile **13** for reinforcing the heating element WT is apparent. A front panel **11** is glued to the first tube register RR**1** at the front side **5** of the heating element WT. A rear panel **12** is glued to the fifth tube register RR**5** at the rear side **6** of the heating element WT. The front panel **11** is preferably made of steel, and the rear panel **12** is preferably made of

aluminum. The connecting tubes **3** are made of a polymer material, preferably polybutylene (polybutene).

[0074] The first vertical convection channel K**1** and the second vertical convection channel K**2** for air, which is heated or cooled between the registers RR**1**, RR**2**, RR**3**, RR**4**, RR**5**, are apparent.

[0075] FIG. **5** shows a heating element or cooling element WT according to the invention in a perspective view from its rear side, together with two brackets H**1**, H**2** to which it is fastened. The supply distributor **1**, the return distributor **2**, and the connecting tubes **3** are schematically indicated. The arrow P**1** indicates the inlet of the supply line into the heating element WT. The arrow P**2** indicates the outlet of the return line from the heating element WT. The heating/cooling element WT also contains a first reinforced hose F**1**, which extends from the inlet of the supply line (at P**1**) to the supply distributor **1**. The heating/cooling element WT also contains a second reinforced hose F**2**, which extends from the outlet of the return line (at P**2**) to the return distributor **2**. A supply line valve V**1** is situated in the supply line, An optional return line valve V**2** is situated in the return line. A vent valve V**3** is situated at the supply distributor **1**.

[0076] FIG. **6** shows an enlarged detail of the upper area of a bracket H**1** or H**2**, with an open lock. A sleeve **14** which is situated at the upper end of the bracket H**1**, H**2** and which extends transversely with respect to the vertical axis of the bracket H**1**, H**2** is apparent. This sleeve **14** contains an internal thread. A disk-shaped actuator **15** is threadedly connected to the sleeve **14**. For this purpose, the actuator **15** contains a set screw **15***a* having an external thread which extends away from the disk-shaped portion of the actuator **15**. The distance of the heating/cooling element WT from the wall may be adjusted by turning the actuator **15**.

[0077] Also apparent is a locking member **16**, at the upper end of the heating/cooling element WT, which is horizontally displaceable along the upper end of the heating/cooling element WT. The locking member **16** contains a recess **16***a* that is complementary to the actuator **15**, in particular complementary to the set screw **15***a* thereof. The two members **15**, **16** may be brought into locking engagement with one another by displacing the locking member **16** until it reaches the actuator **15**, as a result of which the actuator **15** is locked by the locking member **16**. The heating/cooling element WT is thereby locked at its upper end to the brackets H**1**, H**2** by means of two locking members **16**.

[0078] FIG. **7** shows the enlarged detail of the upper area of the bracket H**1**, H**2**, with a closed lock. The locking member **16**, which is in locking engagement with the actuator **15** by means of the mutually complementary formations **15***a* and **16***a*, is apparent.

[0079] FIG. **8** shows an enlarged detail of the lower area of the bracket H**1**, H**2** with an engaged suspension. A suspension member **18** situated at the lower end of the bracket H**1**, H**2** is apparent, which has a recess **18***a* into which a complementary crease **19***a* of a floor panel **19** protrudes.

[0080] The heating/cooling element WT is mounted by initially hanging it on the suspension member **18** at the lower end of the brackets H**1**, H**2**, and then locking it together with the two actuators **15** and the two locking members **16** at the upper end of the brackets H**1**, H**2**.

[0081] In the locked state, on the one hand the locking member **16** is engaged with the actuator **15** by means of the mutually complementary formations **15***a* and **16***a*, and on the other hand the floor panel **19** is engaged with the suspension member **18** by means of the mutually complementary formations **18***a* and **19***a*.

[0082] FIG. **9** shows the heating element WT depicted in FIGS. **1**, **2**, and **3** in the installed state, in its front elevation. From the front, the variants Type ONE with one tube register, Type TWO with three tube registers, and Type THREE with five tube registers all look the same. The valve V**1** is also apparent.

[0083] FIG. **10** shows the thin heating element WT (Type ONE) depicted in FIG. **1**, in a side view. In addition to the heating element WT, the valve V**1** is also apparent.

[0084] FIG. **11** shows the moderately thick heating element WT (Type TWO) depicted in FIG. **2**, in a side view. In this view, the valve V**1** is concealed by the heating element WT.

[0085] FIG. **12** shows the thick heating element WT (Type THREE) depicted in FIG. **3**, in a side view. In this view, the valve V**1** is concealed by the heating element WT.

[0086] FIG. **13**A shows the third exemplary embodiment (Type THREE) of a heating element WT according to the invention with cladding, in a perspective view from the top. FIG. **13**B shows the section of the third exemplary embodiment in a sectional view. The five supply distributors **1** and two convection channels are apparent.

[0087] FIG. **14**A shows a fourth exemplary embodiment (Type FOUR) of a heating element WT according to the invention containing seven tube registers with cladding, in a perspective view from the top. FIG. **14**B shows the section of the fourth exemplary embodiment in a sectional view. Seven supply distributors **1** and three convection channels are apparent.

[0088] FIG. **15**A shows a fifth exemplary embodiment (Type THREE+) of a heating element WT according to the invention, likewise containing seven tube registers with cladding, in a perspective view from the top. FIG. **15**B shows the section of the fifth exemplary embodiment in a sectional view. Seven supply distributors **1** and two convection channels are apparent.

[0089] FIG. **16** shows an enlarged illustration of the fourth exemplary embodiment of the heating element WT according to the invention shown in FIG. **14**B. Apparent in succession from left to right is the respective supply distributor **1** of the seven tube registers, the first being a single register, and the other six tube registers being designed as three double registers C**2** in succession. The first tube register or single register is covered by the cover profile **13**. The next two double registers are each covered by a cover profile **21**. The third and last double register is covered by a cover profile **2'**. A front panel **11** is situated at the front side **5** of the heating element WT and is glued to the first tube register or single register. A rear panel **12** is situated at the rear side **6** of the heating element WT and is glued to the right tube register of the third or last double register.

[0090] FIG. **17** shows a perspective view of the fourth exemplary embodiment, with the large surface at the front side **5**, and a small surface at the end-face side of the heating element WT. FIG. **18** shows another perspective view of the fourth exemplary embodiment from the top; only the front side **5**, and the top side with three longitudinal openings which are associated with the three convection channels, are visible.

[0091] FIG. **19** shows an enlarged illustration of the fifth exemplary embodiment of a heating element WT according

to the invention shown in FIG. **15**B. Apparent in succession from left to right is the respective supply distributor **1** of the seven tube registers, the first two forming a double register C**2**, the middle three forming a triple register C**3**, and the last two forming a double register. The first double register C**2** is covered by the cover profile **13**. The middle triple register C**3** is covered by a cover profile **22**. The last double register C**2** is covered by a cover profile **21'**. A front panel **11** is situated at the front side **5** of the heating element WT and is glued to the first tube register of the double register C**2**. A rear panel **12** is situated at the rear side **6** of the heating element WT and is glued to the right tube register of the last double register C**2**.

[0092] FIG. **20** shows a perspective view of the fifth exemplary embodiment, with the large surface at the front side **5**, and a small surface at the end-face side of the heating element WT. FIG. **21** shows another perspective view of the fifth exemplary embodiment from the top; only the front side **5**, and the top side with two longitudinal openings which are associated with the two convection channels, are visible.

[0093] FIG. **22** shows a section of the fifth exemplary embodiment which extends over the entire installation height, in a sectional view. The upper seven supply distributors **1** and the lower seven return distributors **2** as well as the upper cover profiles **13**, **22**, **21'** of the supply distributors **1** are apparent. The return distributors **2** have no lower cover panels here, In an alternative embodiment, some or all of the return distributors **2** are provided with lower cover profiles, which are preferably identical to the upper cover profiles **13**, **22**, **21'**.

[0094] FIG. **23** shows an enlarged section of the upper area of the fifth exemplary embodiment in a sectional view, the section plane extending transversely with respect to the upper distributors **1** and the cover profiles **13**, **22**, **21'** thereof.

[0095] FIG. **24** shows an enlarged section of the upper area of the fifth exemplary embodiment in a sectional view, the section plane extending along the upper distributors **1**.

[0096] FIG. **25** shows a sectional view transverse to the supply and return distributors **1**, **2** and along the connecting tubes **3** of the fifth exemplary embodiment, with dimension data. The first convection channel K**1** is apparent between the left register unit and the middle register unit. The second convection channel K**2** is apparent between the middle register unit and the right register unit. The two convection channels K**1** and K**2** each have a width of 15 mm to 18 mm.

[0097] FIG. **26** shows a sectional view transverse to the supply distributors **1** of the fourth exemplary embodiment, with dimension data. The overall thickness of this heating element WT is approximately 129 mm.

[0098] FIG. **27** shows a sectional view transverse to the supply distributors **1** of the fifth exemplary embodiment, likewise with dimension data. The overall thickness of this heating element WT is approximately 121 mm.

[0099] FIG. **28** shows a perspective view of a supply collection member S**1** or return collection member S**2** of the heating element WT according to the invention. Five connection fittings for the respective supply distributors **1** of a heating element WT together with five tube registers are apparent. A vent valve V**3** mounted on the supply collection member S**1** is also apparent.

[0100] FIG. **29** shows a perspective view of a supply collection member Si in the installed state in a heating element section, The sections of five supply distributors **1**, the cover profiles **13**, **21**, **21'**, and multiple connecting tubes **3** are apparent.

[0101] FIG. **30** shows another perspective view of the supply collection member S**1** in the installed state. The reference numerals correspond to those of FIG. **29**,

[0102] FIG. **31** shows a rear view of a heating element WT according to the invention, without a rear panel. A plurality of connecting tubes **3** is apparent.

[0103] FIG. **32** shows a sectional view transverse to the supply distributor **1** and along a connecting tube **3** of a first embodiment of the tube register RR according to the invention. It is apparent that the cross-section of the supply distributor **1** is symmetrical with respect to an axis of symmetry SA.

[0104] FIG. **33** shows a sectional view transverse to the supply distributor **1'** and along two parallel connecting tubes **3'** of a second embodiment of the tube register RR' according to the invention. It is apparent that the cross-section of the supply distributor **1'** is symmetrical with respect to an axis of symmetry SA'.

[0105] FIG. **34** shows an enlarged sectional view transverse to the supply distributor **1** of the first embodiment of the tube register RR according to the invention. Two flat surface regions **1***a* and **1***b* are apparent at the outer surface of the supply distributor **1**. The two flat areas **1***a* and **1** *b* are angled relative to one another, preferably at an angle of 90°. It is apparent that the axis of symmetry SA of the cross-section of the supply distributor **1** or the plane of symmetry of the supply distributor **1** extends through the vertex KL of the cross section between the flat areas **1***a* and **1***b*, or through the edge line KL of the supply distributor **1**. This symmetry of the supply distributor **1** facilitates its manufacture by extrusion.

[0106] FIG. **35** shows an enlarged sectional view transverse to the supply distributor **1'** of the second embodiment of the tube register RR' according to the invention. Three flat surface regions **1***a'*, **1***b'*, **1***c'* are apparent at the outer surface of the supply distributor **1'**, the planes of which are likewise angled relative to one another.

[0107] FIG. **36** shows an enlarged sectional view transverse to the supply distributor **1** of the first embodiment of the tube register RR according to the invention during a method step for its manufacture. A first bearing area Li and a second bearing area L**2** are apparent, both of which are used for bearing the supply distributor **1**. The supply distributor **1** is pressed against the two bearing areas L**1** and L**2** by means of a contact force along the arrow L**3**.

[0108] A step drill SB is then used to introduce a stepped borehole, i.e., a through borehole DB having a borehole shoulder BS, through the wall of the supply distributor **1**, which is fixed in place by the bearing areas or force transmission areas L**1**,L**2**, L**3**.

[0109] The first end **3***a* of a connecting tube **3** is then inserted into this stepped borehole DB in the supply distributor **1**, and is then glued and/or welded, preferably by ultrasonic welding, to the supply distributor **1**.

[0110] The statements made with regard to FIGS. **32** through **36** similarly also apply for the return distributor **2**.

[0111] It is noted that in the above description, the terms "heat exchanger," "heating element and/or cooling element," and "heating/cooling element" are interchangeable,

since any of these heat exchangers WT may be used as a heating element or as a cooling element.

1. A tube register (RR) for a heat exchanger (WT), the tube register comprising:

a heating element or cooling element, through which a heat transfer fluid may flow, and which has two distributor lines (**1**, **2**), said first distributor line being a supply distributor and said second line being a return distributor: and

a plurality of connecting tubes (**3**) extending between said supply distributor and said return distributor which fluidically connect said supply distributor to said return distributor:

wherein said supply distributor (**1**) is linear, and said return distributor (**2**) is linear and in parallel with said supply distributor; and

wherein said plurality of connecting tubes (**3**), are situated in a plane, extending between said supply distributor (**1**), and said return distributor (**2**), whereby the connecting sites (P**1**) between the supply distributor (**1**) and the connecting tubes (**3**) are situated eccentrically, relative to the center axis (M**1**) of the supply distributor (**1**), on the supply distributor (**1**), and the connecting sites (P**2**) between the return distributor (**2**) and the connecting tubes (**3**) are situated eccentrically, relative to the center axis (M**2**) of the return distributor (**2**), on the return distributor (**2**).

2. The tube register according to claim **1**, wherein said tube register is made of at least one polymer material.

3. The tube register according to claim **2**, wherein said supply distributor (**1**) and the return distributor (**2**) are made of a first polymer material, and the connecting tubes (**3**) are made of a second polymer material.

4. The tube register according to claim **2**, wherein said supply distributor (**1**) , said return distributor (**2**), and said connecting tubes (**3**) are made of the same polymer material.

5. The tube register according to claim **2** wherein said supply distributor (**1**) and said return distributor (**2**) and said connecting tubes (**3**) are tubes that are manufactured by extrusion, and welded or glued to one another at the connecting sites (P**1**, P**2**).

6. A heat exchanger (WT) comprising: two or more adjacently situated tube registers (RR**1**, RR**2**, . . . , RRn) according to claim **1**.

7. The heat exchanger (WT) according to claim **6**, wherein said adjacently situated fluid inlets of the adjacently situated supply distributors (**1**) are fluidically connected to one another by means of a supply collection member (S**1**), which establishes a fluid connection to the supply line connection (Al) of the heat exchanger (WT), and the adjacently situated fluid outlets of the adjacently situated return distributors (**2**) are fluidicaily connected to one another by means of a return collection member (S**2**), Which establishes a fluid connection to the return line connection (A**2**) of the heat exchanger (WT).

8. The heat exchanger (WT) according to claim **7**, wherein said supply collection member (S**1**) and the return collection member (S**2**) are made of a polymer material, and are preferably manufactured by injection molding.

9. The heat exchanger (WT) according to claim **8**, wherein said supply distributors (**1**) are glued or welded to the supply collection member (S**1**) in the area of their fluid connection to same, and the return distributors (**2**) are glued or welded to the return collection member (S**2**) in the area of their fluid connection to same.

10. The heat exchanger (WT) according to claim **6**, further comprising a plate-like cover element (**11** or **12**), said cover element is made of a metal mesh and/or a metal sheet, at least on one of its large surfaces i.e., on its front surface (**5**) and/or on its rear surface (**6**).

11. The tube register according claim **4** wherein said supply distributor (**1**) and said return distributor (**2**) and said connecting tubes (**3**) are tubes that are manufactured by extrusion, and welded or glued to one another at the connecting sites (P**1**, P**2**).

12. The heat exchanger according to claim **6**, wherein at least one tube register of the heat exchanger is made of at least one polymer material.

13. The tube register according to claim **6**, wherein at least one supply distributor (**1**) and at least one return distributor (**2**) are made of a first polymer material, and at least one connecting tubes (**3**) is made of a second polymer material.

14. The tube register according to claim **6**, wherein at least one supply distributor (**1**), at least one return distributor (**2**), and at least one connecting tube (**3**) is made of the same polymer material.

* * * * *