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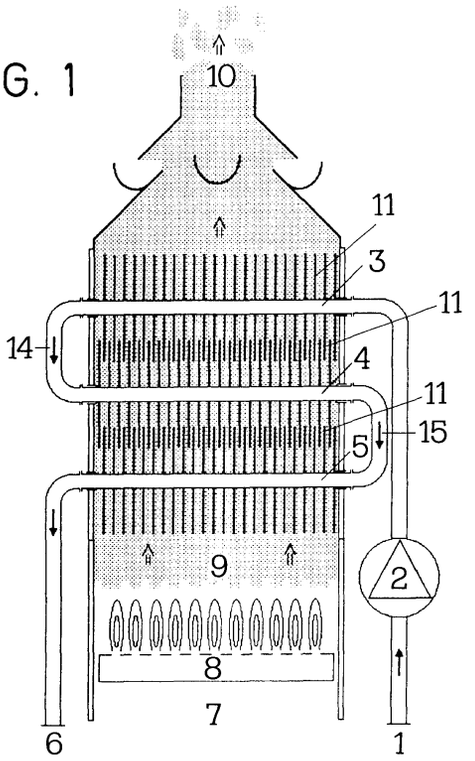
(54) Improved gas-liquid heat exchanger

(57) The invention relates to gas - liquid heat exchanger, comprising at least two heat exchanger elements, each one providing at least one liquid passage channel (3, 4, 5), or liquid side, externally providing a finned pack (7), or gas side, with fins (7) substantially parallel each other, coupled in correspondence of their root with said at least one passage channel (3, 4, 5), said at least two heat exchangers being in hydraulic communication each other with a liquid passage from one element to the other one in a direction opposite with respect to the gas motion direction, and the finned packs (7) of the passage channels (3, 4, 5) of the relevant exchanger elements being penetrable each other, the penetration rate of the finned packs (7) being variable.

FIG. 1



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Description

[0001] The present invention relates to an improved gas liquid heat exchanger.

[0002] More particularly, the invention relates to an exchanger of the above kind realised in such a way to allow to obtain remarkable advantages with respect to the known exchangers.

[0003] As it is well known to those skilled in the art, liquid - gas heat exchangers transfer heat from a gas to a liquid, or vice versa. This kind of exchanger is often employed in different fields.

[0004] For example, one of the fields extensively employing this kind of exchanger is that of heating, with particular reference to the smokes - water main exchanger in the heat generators (boilers).

[0005] It is an element for boilers and mixed boilers for heating and sanitary hot water.

[0006] Hot smokes are developed by combustion in air of gaseous, liquid or solid combustibles feeding a burner, and water heated is used as thermal carrier fluid for heating rooms by radiators and for heating water destined to the human use by a further water - water exchanger.

[0007] In this field it is included the solution suggested according to the present invention that allows to realise a gas - liquid heat exchanger having performances remarkably better than the solutions presently available on the market.

[0008] Main object of the present invention is that of providing a heat exchanger that could be universally employed as main exchanger in the heating field.

[0009] Further object of the present invention is that of providing a gas - liquid heat exchanger able to operate in a gas condensation regime.

[0010] Still another object of the present invention is that of providing a solution extremely solid and that can be easily cleaned.

[0011] A further object of the present invention is that of providing a heat exchanger providing different compositions of the same elements to realise exchangers usable for different apparatuses.

[0012] These and other results are obtained, according to the present invention, by the realisation of a gas - liquid heat exchanger having the structure of fins of the elements allowing the variation of the penetration of the fins between two or more elements, with the gas side provided with fins to allow the insertion of a plurality of serially overlapped elements and/or to couple some put side by side series, to realise increasing exchange powers, thus exploiting in the best way the countercurrent gas - liquid exchange, and eventually the finned liquid side, comprised of one or more channels comprising one or more circuits.

[0013] It is therefore specific object of the present invention a gas - liquid heat exchanger, comprising at least two heat exchanger elements, each one providing at least one liquid passage channel, or liquid side, externally providing a finned pack, or gas side, with fins substantially parallel each other, coupled in correspondence of their root with said at least one passage channel, said at least two heat exchangers being in hydraulic communication each other with a liquid passage from one element to the other one in a direction opposite with respect to the gas motion direction, and the finned packs of the passage channels of the relevant exchanger elements being penetrable each other, the penetration rate of the finned packs being variable.

[0014] Preferably, according to the invention, each exchanger element can provide one or more liquid passage channel placed parallel and hydraulically connected in parallel, in series or in another way.

[0015] Furthermore, according to the invention, said passage channels of each exchanger element can be co-planar,

[0016] Always according to the invention, fins can be also provided inside said passage channels.

[0017] Still according to the invention, exchangers according to the invention can be put side by side.

[0018] Furthermore, the exchanger according to the invention can be comprised of a plurality of hydraulic circuits, for example for primary water and sanitary water.

[0019] According to the invention, in a preferred embodiment, two, three or more overlapped exchanger elements are provided.

[0020] The present invention will be now described, for illustrative but not limitative purposes, according to its preferred embodiments, with particular reference to the figures of the enclosed drawings, wherein:

figure 1 is a lateral schematic view of a first embodiment of the gas - liquid heat exchanger according to the invention;
figure 2 is a lateral view of a particular of the exchanger of figure 1;
figure 3 is a section view taken along line III-III of figure 2;
figure 4 is a top view of a particular of the exchanger of figure 1;
figure 5 is a section view taken along line V-V of figure 4;
figure 6 is a lateral schematic view of a second embodiment of the gas - liquid heat exchanger according to the invention;
figure 7 is a lateral view of a particular of the exchanger of figure 6;
figure 8 is a section view taken along line VIII-VIII of figure 7;
figure 9 is a top view of a particular of the exchanger of figure 6; and
figure 10 is a section view taken along line X-X of figure 9.

[0021] Observing first figures 1 - 5, a natural draught boiler is shown provided with a heat exchanger according to the invention, providing a primary water inlet 1, on

which a pump 2 is provided, to send water through the elements of the exchanger, in this case three elements, respectively indicated by reference numbers 3, 4 and 5.

[0022] By reference number 6 the outlet of primary water is indicated.

[0023] Comburent air enters through inlet 7, passing through boiler 8 and combustion chamber 9, and then exits through the chimney or smokes outlet 10.

[0024] As already said, in this embodiment, three overlapped elements 3, 4, 5 are provided (see figure 3), each one of them outside having a finned pack, comprising the "gas side", the fins 11 of which are mainly parallel each other and coupled in correspondence of their root with the liquid passage channel, comprising the "liquid side".

[0025] In this solution, three parallel channels (see figure 4) are provided for each element 3, 4, 5, hydraulically connected each other by manifold 12 and 13, and connected by connectors 14 and 15 to the upper and/or lower elements.

[0026] Also within the channels can be provided one or more fins (not shown) to increase the exchange surface for the liquid.

[0027] The interconnection realised, and shown in the figures, exploiting the countercurrent passage of the two fluids, so that in any element various coplanar channels covered by the fluid are perpendicular to the smokes direction and are parallel each other; liquid flow from an element to the immediately overlapped one occurs in such a way that water motion from an element to the following one is opposed with respect to the smokes motion.

[0028] Dividing the exchanger according to the invention into overlapped elements a continuity absence is realised among the fins 11 of the various elements and thus the absence of thermal points between them, so that the countercurrent exchange can be better realised.

[0029] In fact, with the same exchange surface, passage between the two countercurrent fluids, with respect to the equi - current passage and to the passage according to a perpendicular direction, increase the thermal capability exchanged between the two fluids.

[0030] Obviously, a plurality of exchanger according to the invention can be put side by side, eventually hydraulically interconnected, to realise a bigger single exchanger able to exchange increasing thermal power. Various elements to be overlapped and/or put side by side can be the equal or different each other, or partly equal each other.

[0031] Observing now figures 6 - 10, it is shown a second embodiment of the exchanger according to the invention. The same numeric references will be used to indicate the elements corresponding to those of the previous embodiment.

[0032] In this case, it is shown a forced draught boiler, wherein fan 16 is provided, helping in extraction of the smokes.

[0033] In the embodiment shown, two overlapped elements 4, 5 are provided, instead of three of the previous embodiment, but it is to be understood that said solution could be also adopted in the preceding embodiment and vice versa.

[0034] Exchanger according to the invention could be in any case "monothermal" or "bithermal" or "plurithermal", being it possible to englobe one or more hydraulic circuits, of which, for example, one for "primary" water for heating purposes, and the second one for the preparation of sanitary hot water.

[0035] Fins 11 of the single elements 3, 4, 5 are realised in such a way that in the overlapping of more elements a pre-established penetration among the same elements can be obtained. In fact, it can be observed from figure 1 that penetration of fins 11 is less than in figure 6.

[0036] Penetration of fins 11 can vary between a minimum value (zero faced surface) and a maximum value (maximum faced surface).

[0037] With the increasing of the penetration, passages through which gas can pass are narrowed, thus obtaining two important effects for the behaviour of the exchanger;

a) with the same gas flow rate the total aerodynamic resistance of the exchanger to the passage of the same gases increases;
b) with the same gas flow rate, fluidodynamic exchange coefficient of the exchanger increases, thus increasing the exchangeable thermal power.

[0038] In the heating field, with the same elements combined and suitably "penetrated" is possible realise three different kind of exchangers and thus of boilers:

- natural draught boiler (figures 1 - 5);
- forced draught boiler (figures 6 - 10);
- smokes steam condensation boiler (not shown).

[0039] By the solution according to the invention, with the same thermal smokes flow rate, in natural draught boilers a reduced penetration is necessary to limit the aerodynamic resistance to the smokes passage, so that the whole finned surface must be greater, in forced draught boilers penetration that can be realised is greater since the greater aerodynamic resistance is won by mechanical means forcing the smokes flow, thus the higher exchange coefficient that can be obtained allow to have a lower whole finned surface, and, finally, in the forced flow condensation boiler finned surface must be greater to obtain a higher cooling of smokes and to recover the condensation latent heat of steam, thus the exchanger could have either more elements or a greater penetration of the fins 11 with respect to a forced draught without condensation; spatial direction of smokes will occur from up toward down to promote the outflow and collection of condensate.

[0040] In case of use of the heat exchanger according

to the invention in different fields, it is possible to foresee different penetration of the fins on the basis of the specific operation needing of the exchanger.

[0041] It can further be supposed the use of the exchanger when the liquid transfers heat to the gas.

[0042] To realise fins 11 and any single element 3, 4 or 5 of the exchanger according to the invention, it will be used the specific materials for each case, with the most convenient technology (for example pressure diecasting or casting into sand or shell for aluminium, or moulding and braze welding for copper), and the most suitable shape to satisfy the specific needing.

[0043] Furthermore, their mechanical resistance should be appropriate to withstand to stresses induced by inner pressure of liquid and from temperature variation, to corrosion of gases and its condensates, and appropriate to withstand to the mechanical and chemical actions during incrustations, soot and dirty cleaning.

[0044] The present invention has been described for illustrative but not limitative purposes, according to its preferred embodiments, but it is to be understood that modifications and/or changes can be introduced by those skilled in the art without departing from the relevant scope as defined in the enclosed claims.

Claims

1. Gas - liquid heat exchanger, characterised in that it comprises at least two heat exchanger elements, each one providing at least one liquid passage channel, or liquid side, externally providing a finned pack, or gas side, with fins substantially parallel each other, coupled in correspondence of their root with said at least one passage channel, said at least two heat exchangers being in hydraulic communication each other with a liquid passage from one element to the other one in a direction opposite with respect to the gas motion direction, and the finned packs of the passage channels of the relevant exchanger elements being penetrable each other, the penetration rate of the finned packs being variable.

2. Gas - liquid heat exchanger according to claim 1, characterised in that each exchanger element provides one or more liquid passage channel placed parallel and hydraulically connected in parallel, in series or in another way.

3. Gas - liquid heat exchanger according to one of the preceding claims, characterised in that said passage channels of each exchanger element are be co-planar.

4. Gas - liquid heat exchanger according to one of the preceding claims, characterised in that, fins are also provided inside said passage channels.

5. Gas - liquid heat exchanger according to one of the preceding claims, characterised in that more exchangers are put side by side.

6. Gas - liquid heat exchanger according to one of the preceding claims, characterised in that comprises a plurality of hydraulic circuits, for example for primary water and sanitary water.

7. Gas - liquid heat exchanger according to one of the preceding claims, characterised in that two, three or more overlapped exchanger elements are provided.

8. Gas - liquid heat exchanger according to each one of the preceding claims, substantially as illustrated and described.

FIG. 6

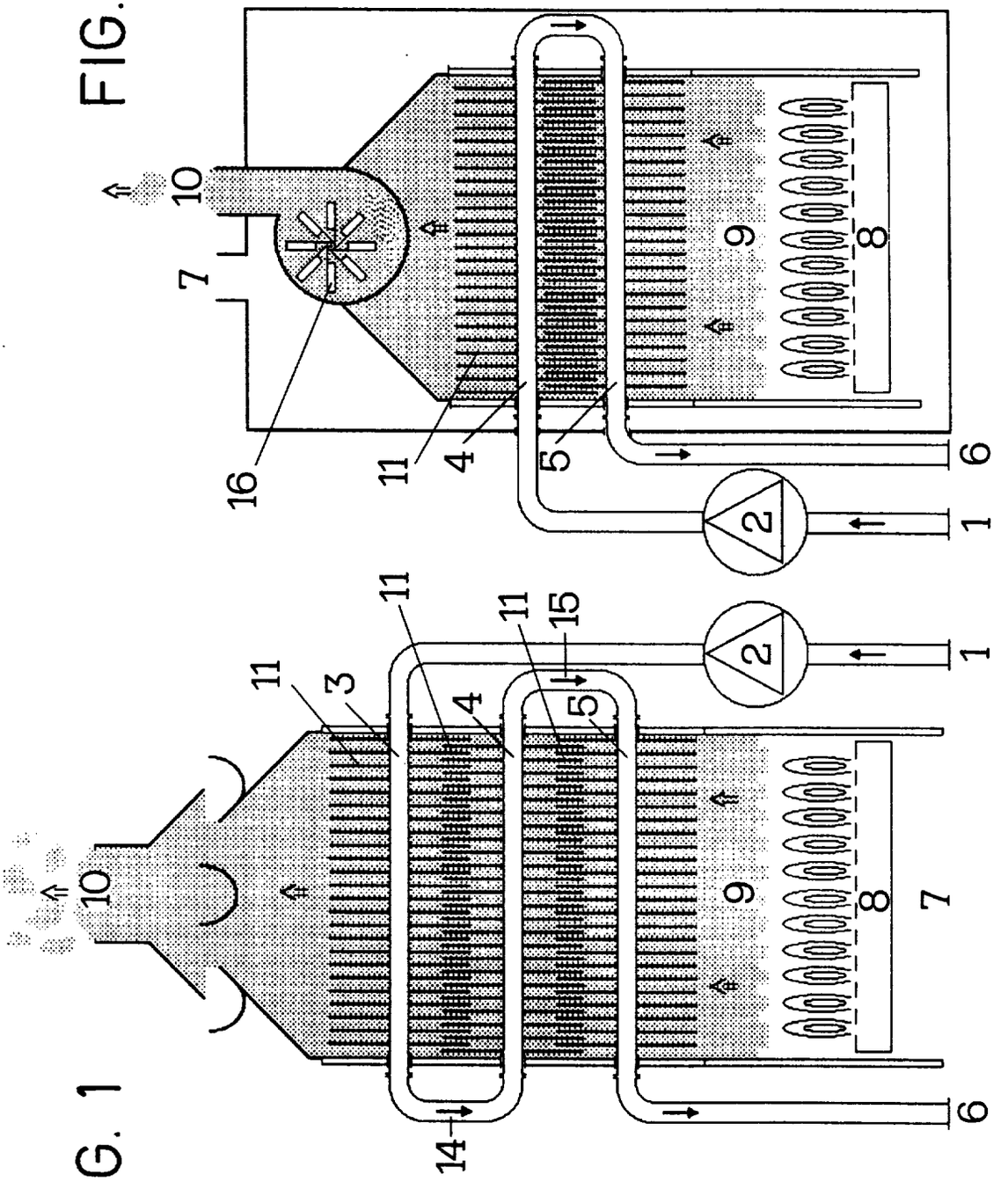

FIG. 1

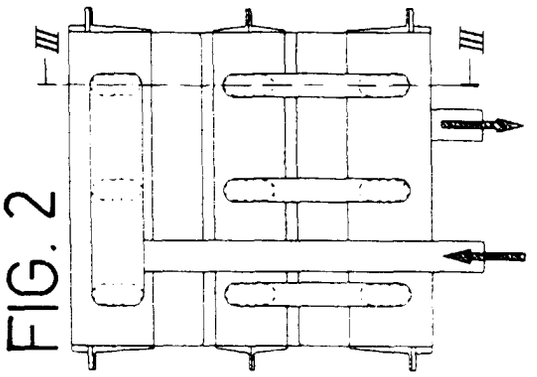

FIG. 2

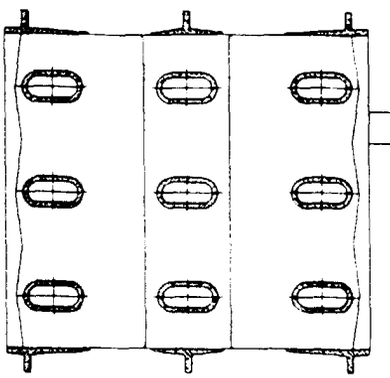

FIG. 5

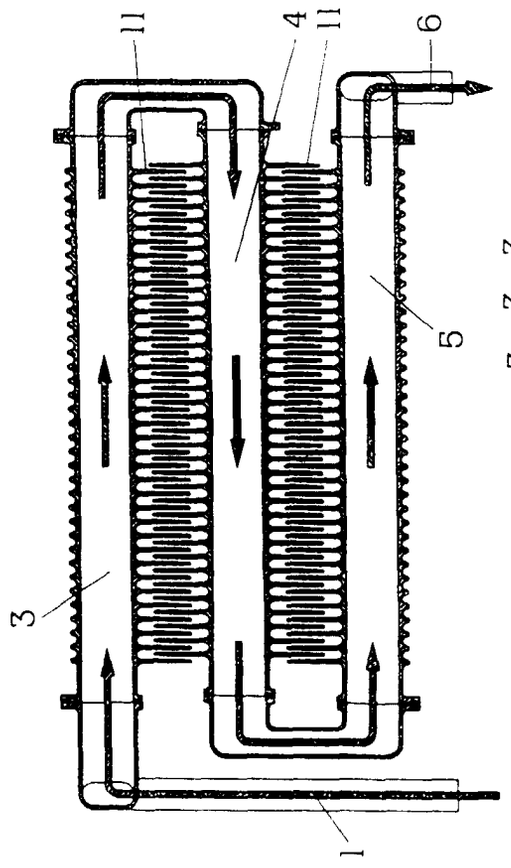

FIG. 3

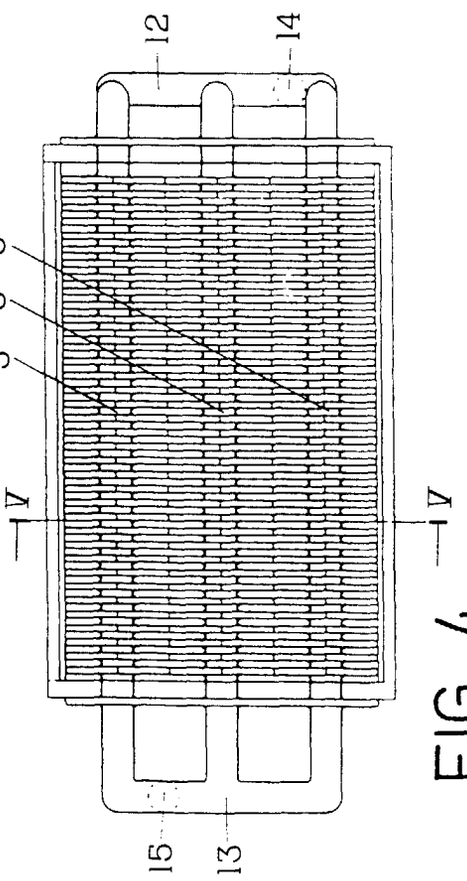

FIG. 4

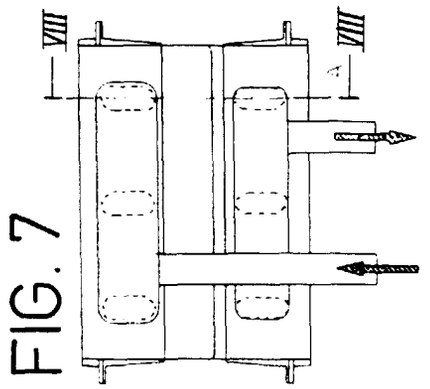

FIG. 7

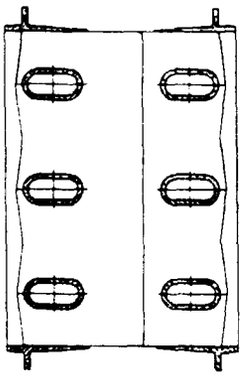

FIG. 10

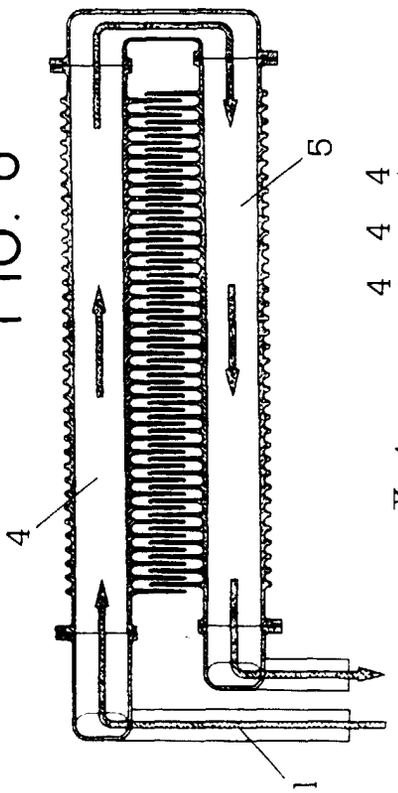

FIG. 8

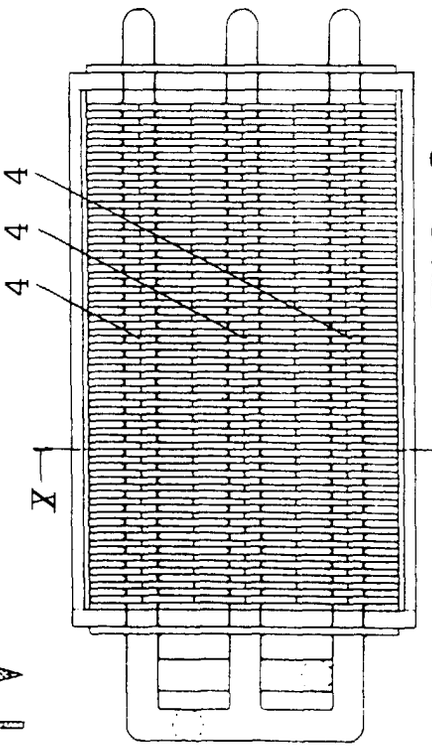

FIG. 9