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(54) Heat exchanger.

(57) A heat exchanger of light weight having high heat exchange efficiency which comprises a chamber having an inlet and an outlet for a fluid, a columnar body positioned vertically at the center of the chamber and a plurality of pipes surrounding spirally the columnar body and arranged side by side at substantially a horizontal position, the pipes being supported by a plurality of supports fixed to the outer wall of the columnar body or the inner wall of the chamber.

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HEAT EXCHANGER

The present invention relates to a heat exchanger. More particularly, it relates to a heat exchanger of light weight having high heat exchange efficiency.

Generally, heat exchangers used in water heaters are made of copper or its alloy, which has good heat conductivity and provides high heat exchange efficiency. Since, however, copper and its alloy are apt to be corroded on combustion of urban gas or propane gas, the heat exchangers require to have thick walls. This makes the heat exchangers heavier.

The main object of the present invention provides a heat exchanger of light weight, which has good heat exchange efficiency.

The heat exchanger of the invention comprises a chamber having an inlet and an outlet, a columnar body positioned vertically in the center of the chamber and a plurality of pipes surrounding spirally the columnar body and supported by a plurality of supports provided on the outer wall of the columnar body and projected outwardly or on the inner wall of the chamber and projected inwardly, said pipes being arranged side by side at substantially a horizontal position between the outer wall of the columnar body and the inner wall of the chamber.

The characteristic feature of the heat exchanger of the invention resides in having a plurality of pipes for

a fluid surrounding spirally a columnar body in the space between the inner wall of a chamber and the outer wall of the columnar body located vertically at the center of the chamber, said pipes being arranged side by side at substantially a horizontal position, to let flow a fluid spirally along the columnar body in contact with the outer surfaces of the pipes.

As stated above, the heat exchanger of the invention comprises as the essential elements a chamber, a columnar body, supports and pipes.

The chamber and the columnar body may be made of same or different materials but are preferably made of a same material. The materials may be any one insofar as they are resistant to heat and corrosion. Specific examples are iron, iron alloy, stainless steel, aluminum, aluminum alloy, copper, copper alloy, etc. Other anti-corrosive metals such as Ti, Zr, Ta, Mo and Nb, and their alloys are also usable. The chamber is provided with an inlet and an outlet, which may be used respectively for introduction and discharge of a fluid for heating or to be heated. The columnar body may be constructed, for instance, in a shape of cylindrical or square pipe optionally closed at both ends or of column or square pillar optionally provided with a hollow at the center. In general, the use of a hollow columnar body closed at both ends is preferred for making the weight of the heat exchanger light and saving the apparatus cost. When the columnar body is hollow and opened at both ends,

any fluid for heating or to be heated may flow therein.

The supports and the pipes may be also made of same or different materials. Examples of the usable material are substantially the same as explained for the chamber and the columnar body. The supports, which may be shaped, for instance, in a bar-like or open-sided square form, are fixed to the outer wall of the columnar body or the inner wall of the chamber by any conventional means (e.g. welding). In view of their purpose to support the pipes, the number and position of the supports may be suitably chosen. The pipes may be constructed in a single structure or in a double structure. When constructed in a double structure, the inside of each pipe may be made of a corrosion-resistant metal such as Ti, Zr, Ta, Mo and Nb and their alloys and the outside made of iron or its alloy. The pipes are spirally wound around the columnar body and arranged side by side at substantially a horizontal position. They are closely contacted each other. The larger number of spiral winding affords a better result and may be suitably selected taking heat exchange rate, strength of material, etc. into consideration.

More detailed explanations on the heat exchanger of the invention are given below with reference to the accompanying drawings wherein:

Fig. 1 is a schematic side view of an embodiment of the heat exchanger according to the invention;

Fig. 2 is a schematic upper plane view taken along

the line A-A in Fig. 1;

Fig. 3 is a partially eliminated schematic side view of an example of a water heater incorporated with the heat exchanger of the invention;

Fig. 4 is a schematic sectional view of the water feeding section of the water heater as shown in Fig. 3; and

Fig. 5 is a partially eliminated schematic side view of another example of a water heater incorporated with the heat exchanger of the invention.

In Figs. 1 and 2, the columnar body 1 is provided with supports 3,.3, ... at plural positions by welding. A pair of supports 3 and 3 form a space of open-sided square shape in section, and the space holds pipes 2, 2 and 2, which surround spirally the columnar body 1 and are arranged side by side at substantially a horizontal position. The number and sectional shape of the pipes are optional. The number and form of the supports are also optional.

In Figs. 3 and 4 showing an example of a water heater incorporated with the heat exchanger as shown in Fig. 1, the columnar body 1 is constructed in a hollow column closed at the upper and lower ends and placed vertically at the center of the chamber 5 on the bottom plate 7. In each pair of supports 3 and 3, the pipes 2, 2 and 2 are held and arranged in a closely contacted relationship, and also the utmost inside pipe and the utmost outside pipe are respectively kept in close contact with the outer wall of the columnar body 1 and the inner wall of the chamber 5, whereby

a spiral passage is formed between the outer wall of the columnar body 1 and the inner wall of the chamber 5. The chamber 5 has an outer shell 6 to make a passage.

In order to obtain hot water by the use of the water heater having the above construction, tap water (W) is supplied from a valve through the pipe (P) to the water feeding section 4. Then, the water flows into the pipes 2, 2 and 2, goes up spirally and reaches to the water discharge section 11. At this stage, combustible gas (G) is ignited at the gas burner 8 so that heating gas goes up spirally along the columnar body 1 as indicated by the arrow line and is discharged from the outlet 10. When air is introduced from the inlet 9, it can be pre-heated during the flowing through the passage between the chamber 5 and the outer shell 6 so that the heating gas is able to obtain a higher temperature. Heat exchange is effected between the water flowing in the pipes and the heating gas flowing in the chamber. As the result, the heating gas is cooled to a lower temperature such as about 50°C and discharged from the outlet 10, while the water (H) is heated to a higher temperature such as about 80 to 90°C and taken out from the water discharge section 11.

Fig. 5 shows another example of a water heater incorporated with the heat exchanger of the invention wherein the supports 3, 3, ... are fixed not to the outer wall of the columnar body 1 but to the inner wall of the chamber 5. Further, the chamber 5 is not provided with an

outer shell so that air is not pre-heated. Heating of water may be effected in the same manner as in the water heater shown in Fig. 3.

As understood from the above, the heat exchanger of the invention is extremely large in the contact area between heating gas and the pipes, through which a fluid to be heated flows, so that the fluid can be efficiently heated. Thus, the heat exchanger has a high heat exchange rate.

What is claimed is:

1. A heat exchanger which comprises a chamber having an inlet and an outlet for a fluid, a columnar body positioned vertically at the center of the chamber and a plurality of pipes surrounding spirally the columnar body and arranged side by side at substantially a horizontal position, the pipes being supported by a plurality of supports fixed to the outer wall of the columnar body or the inner wall of the chamber.

2. The heat exchanger according to claim 1, wherein a fluid for heating flows from the inlet of the chamber, goes up spirally along the columnar body in the chamber and is discharged from the outlet of the chamber, while a fluid to be heated flows spirally through the pipes, whereby heat exchange is effected between the fluid for heating and the fluid to be heated.

3. The heat exchanger according to claim 1, wherein the pipes are arranged between the outer wall of the columnar body and the inner wall of the chamber and closely contacted each other, and the utmost inside pipe and the utmost outside pipe are respectively in contact with the outer wall of the columnar body and the inner wall of the chamber.

Fig. 1

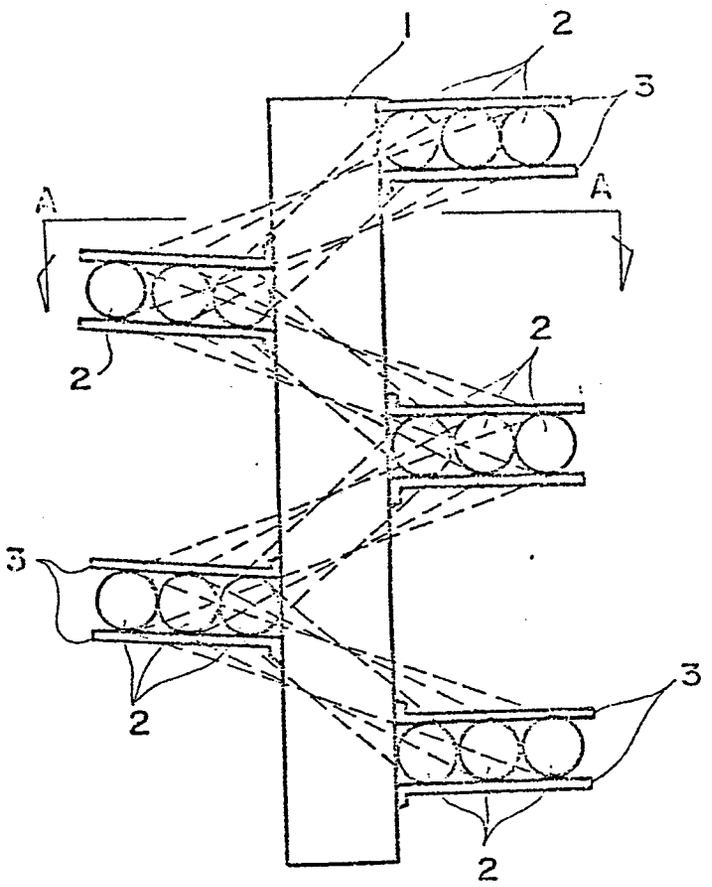

Fig. 2

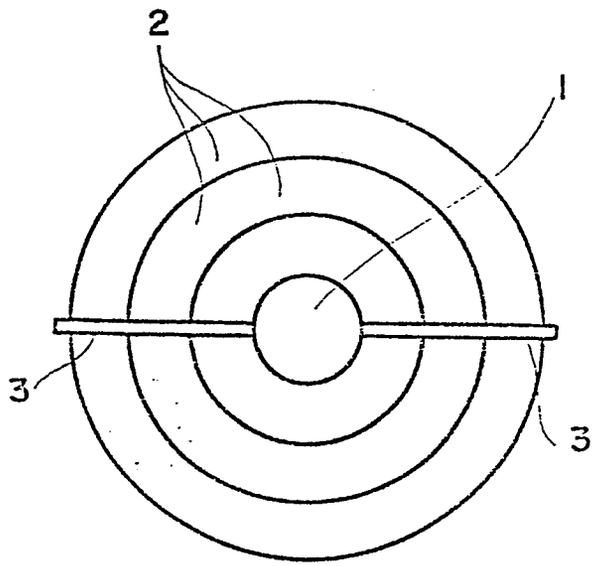

Fig. 3

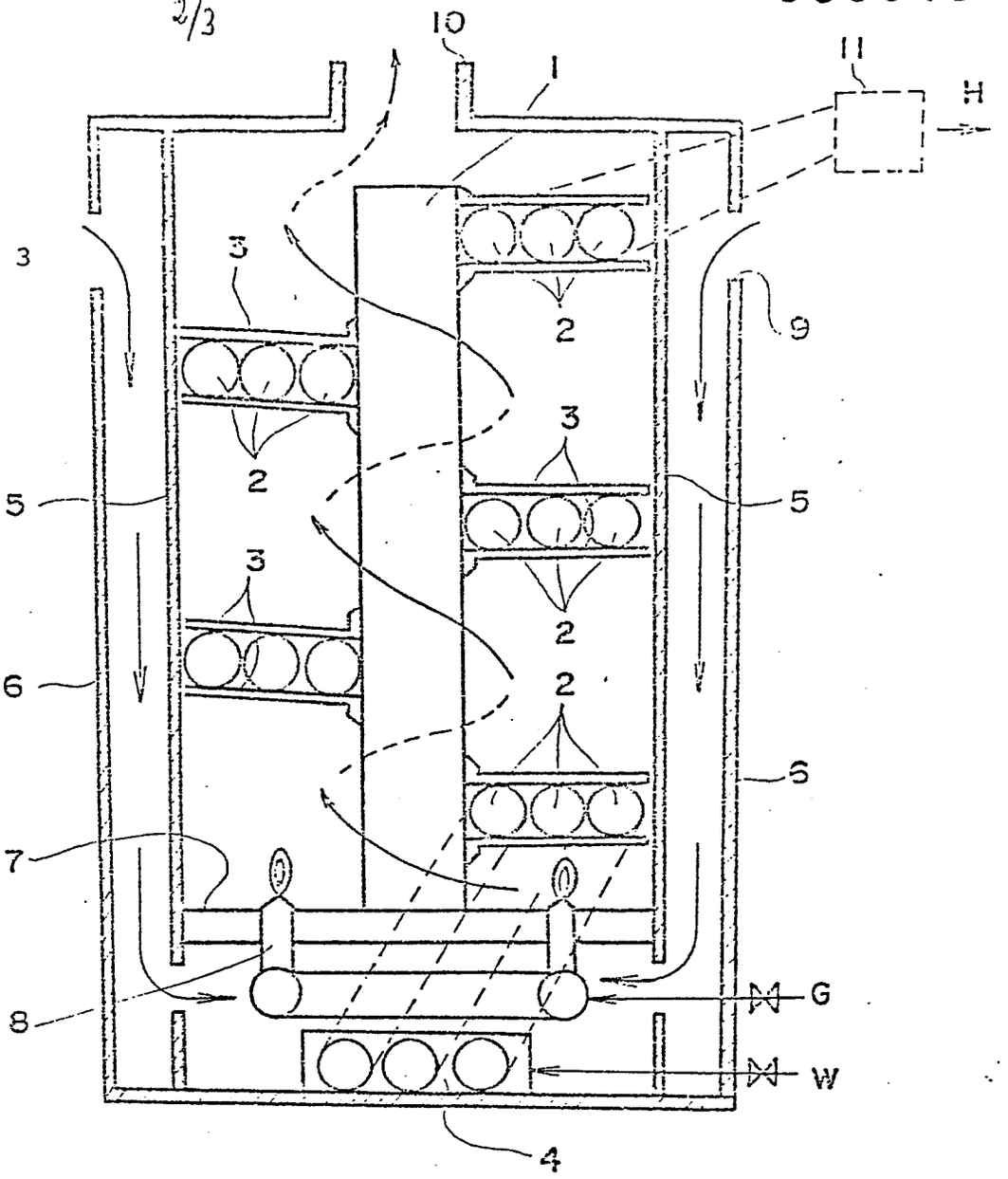

Fig. 4

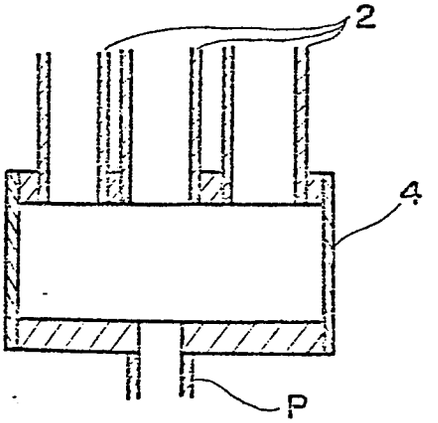

Fig. 5