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## (54) Heat exchanger for a dyeing machine

(57) A heat exchanging apparatus for increasing/decreasing dye temperature of a gas-liquid dyeing machine, including a heat exchanger (10) installed between the inlet (31) and outlet (32) of the dye-circulating pipe (30) of the dyeing machine (20). At least one partitioning layer (11) is disposed in an interior of the heat exchanger (10) to partition the interior into a gas flowing space (13) and a dye flowing space (12). The dye flowing space (12) has a dye inlet (121) and a dye outlet (122) which are respectively connected to the dye outlet (32) and dye inlet (31) of the dyeing machine (20). The gas flowing space (13) has a gas inlet (131) and a gas outlet (132). The gas inlet (131) is connected to a cold air source (40) and a steam source (50). The gas outlet (132) is connected to a water condenser (60). Multiple tubular vacuum thermally conductive elements (14) are inserted on the partitioning layer (11). Each thermally conductive element (14) has two ends which respectively extend into the gas flowing space (13) and the dye flowing space (12). By means of the high efficiency heat exchange of the vacuum thermally conductive elements (14), the temperature of the circulated dye can be quickly increased/decreased and more stably controlled.

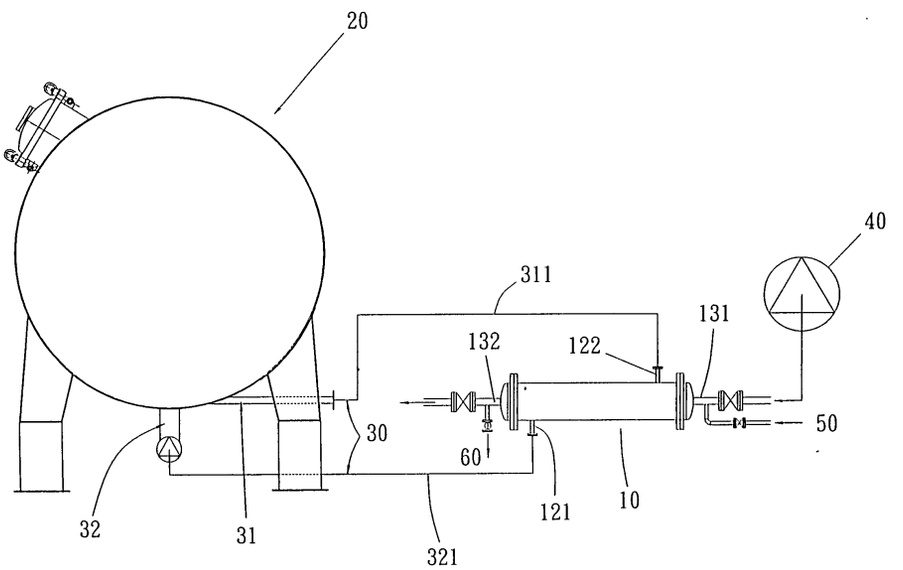


Fig. 1

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## Description

### BACKGROUND OF THE INVENTION

**[0001]** The present invention is related to an improved heat exchanging apparatus for increasing/decreasing dye temperature of a gas-liquid dyeing machine. The heat exchanging apparatus includes a heat exchanger installed between the inlet and outlet of the dye-circulating pipe of the gas-liquid dyeing machine. The interior of the heat exchanger is partitioned by a partitioning layer into a gas flowing space and a dye flowing space. Multiple high efficiency vacuum thermally conductive elements are inserted on the partitioning layer for achieving heat exchange between the dye and the gas source at high efficiency. Each thermally conductive element has two ends which respectively extend into the gas flowing space and the dye flowing space. Therefore, the evenness of dyeing and production efficiency are greatly enhanced and the waste of water resource and energy is avoided.

**[0002]** With respect to a gas-liquid fabric dyeing machine, it has been long since requi red to have low bath ratio, high fabric speed, short dyeing time and high evenness of dyeing as well as save labor and energy. All the above issues are closely related to the heat exchanger for controlling the temperature of the dye of the dyeing machine. Therefore, it is a primary object for the manufacturers of fabric dyeing machines to enhance the working efficiency of the heat exchanger. The existent heat exchangers for circulated dye remain to employ cold water and steam for decreasing/increasing the temperature of the dye. It is known that it is necessary to use a great amount of cooling water for cooling the dye. Such cooling water must go through high energy cooling or heating for recycle and reuse. Therefore, during the cooling procedure of the dye, the energy cost for the cooling water or water resource is great and considerable. Therefore, it is necessary to provide a high efficiency heat exchanging apparatus for the circulate dye of the gas-liquid dyeing machine to lower the cost for fabric dyeing operation and avoid waste of energy and resource.

### SUMMARY OF THE INVENTION

**[0003]** It is therefore a primary object of the present invention to provide a heat exchanging apparatus for increasing/decreasing dye temperature of a gas-liquid dyeing machine. The heat exchanging apparatus includes a heat exchanger. At least one partitioning layer is disposed in an interior of the heat exchanger to partition the interior into a gas flowing space and a dye flowing space. Multiple tubular vacuum thermally conductive elements are inserted on the partitioning layer. Each thermally conductive element has two ends which respectively extend into the gas flowing space and the dye flowing space. Under extremely low temperature difference, the vacuum thermally conductive elements can achieve apparent and high efficiency heat exchange. Therefore, the heat exchange efficiency is greatly enhanced and the temperature can be stably controlled. Moreover, the air is directly used for cooling the dye. The air and steam have close thermally conductive characteristics. Therefore, the physical defects of the dyeing machine caused by too great difference between heat exchanging media can be reduced. Also, the waste of energy is avoided and the high exchanger efficiency is greatly enhanced.

**[0004]** The present invention can be best understood through the following description and accompanying drawings wherein:

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0005]**

Fig. 1 is a view showing that the present invention is applied to a dyeing machine;
Fig. 2 is a perspective assembled view of a first embodiment of the present invention;
Fig. 3 is a perspective exploded view of the first embodiment of the present invention;
Fig. 4 is a perspective partially exploded view of the first embodiment of the present invention;
Fig. 5 is a perspective view of the vacuum thermally conductive element of the present invention;
Fig. 6 is a perspective view showing that the vacuum thermally conductive elements are inserted on the partitioning layer of the present invention;
Fig. 7 is a perspective exploded view of a second embodiment of the present invention; and
Fig. 8 is a perspective partially exploded view of the second embodiment of the present invention.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0006]** Please refer to Fig. 1. The heat exchanger 10 of the present invention is installed between the inlet 31 and outlet 32 of the dye-circulating pipe 30 of a dyeing machine 20. Referring to Figs. 2 to 6, the interior of the heat exchanger 10 is partitioned by at least one partitioning layer 11 into a dye flowing space 12 and a gas flowing space 13. The dye flowing space 12 has a dye inlet 121 and a dye outlet 122 which are respectively connected to bypasses 321, 311 corresponding to the outlet 32 and inlet 31 of the dye-circulating pipe 30. The gas flowing space 13 has a gas inlet 131 and a gas outlet 132. One end of the gas inlet 131 can be connected to a cold air source 40 such as a cold wind fan or an air conditioner. In addition, the end of the gas inlet 131 is bypassed to connect with a steam source 50. The gas outlet 132 is bypassed to connect with a water condenser 60. Certain switches are disposed on the gas inlet and gas outlet and the pipelines for controlling the in-

coming/outgoing of the gas or steam.

**[0007]** Multiple vacuum thermally conductive elements 14 are inserted and locked on the partitioning layer 11. Each thermally conductive element 14 is a tubular body with a substantially vacuumed interior. Li ttle thermally conductive medium 141 ( such as water ) is contained in the tubular body. Two ends of the tubular body respectively extend into the dye flowing space 12 and the gas flowing space 13 on two sides of the partitioning layer 11. When the circulated dye needs to be cooled, the cold air source 40 sends in cold air from the gas inlet 131. The thermally conductive medium 141 at the end of the vacuum thermally conductive element 14 in the dye flowing space 12 absorbs heat and evaporates. Then the thermally conductive medium 141 quickly flows to the other end of the vacuum thermally conductive element 14 in the gas flowing space 13 to dissipate heat and condense. Then the vacuum thermally conductive element 14 is further circulated to the end of the vacuum thermally conductive element 14 in the dye flowing space 12 to absorb heat. Accordingly, due to the high thermal conductivity of the vacuum thermally conductive element 14, the temperature of the circulated dye can be quickly and truly lowered. Reversely, when the temperature of the circulated dye needs to increase, steam is input to the gas flowing space 13. Under such circumstance, the direction of heat exchange is reversed and the temperature of the dye can be quickly increased. Under extremely low temperature difference, the vacuum thermally conductive element 14 can achieve apparent and high efficiency heat exchange. Therefore, the heat exchange efficiency is enhanced and the temperature can be stably controlled. This helps in enhancing even dyeing.

**[0008]** Referring to Figs. 3 to 8, the partitioning layer 11 can be a plane board to evenly divide the interior of the heat exchanger into at least two flowing spaces. Alternatively, the partitioning layer 11A can be a concentric wall which divides the interior space of the heat exchanger into an inner and an outer concentric flowing spaces. The vacuum thermally conductive elements 14 are also inserted on the partitioning layer with two ends respectively extending into the two flowing spaces.

**[0009]** In conclusion, the present invention provides a high efficiency heat exchanging apparatus which employs cold air and steam for cooling and heating the dye. The cold air and steam have good thermal conductivity and low pollution. Therefore, the cooling and heating are speeded and the energy is saved. In addition, the dyeing time is shortened and the pollution is reduced. Also, the evenness of dyeing is enhanced.

**[0010]** The above embodiments are only used to illustrate the present invention, not intended to limit the scope thereof. Many modifications of the above embodiments can be made without departing from the spirit of the present invention.

## Claims

1. A heat exchanging apparatus for increasing/decreasing dye temperature of a gas-liquid dyeing machine, the heat exchanging apparatus comprising a heat exchanger, at least one partitioning layer being disposed in an interior of the heat exchanger to partition the interior of the heat exchanger into a gas flowing space and a dye flowing space, the dye flowing space having a dye inlet and a dye outlet which via pipelines are respectively connected to a dye outlet and a dye inlet of the dyeing machine, the gas flowing space having a gas inlet and a gas outlet, the gas inlet being connected to a cold air source, multiple tubular vacuum thermally conductive elements being inserted on the partitioning layer, each thermally conductive element having two ends which respectively extend into the gas flowing space and the dye flowing space.

2. The heat exchanging apparatus for increasing/decreasing dye temperature of the gas-liquid dyeing machine as claimed in claim 1, wherein the gas inlet of the gas flowing space is further connected to a steam source via a pipeline.

3. The heat exchanging apparatus for increasing/decreasing dye temperature of the gas-liquid dyeing machine as claimed in claim 2, wherein the gas outlet of the gas flowing space is connected to a water condenser via a pipeline.

4. The heat exchanging apparatus for increasing/decreasing dye temperature of the gas-liquid dyeing machine as claimed in claim 1, 2 or 3, wherein each vacuum thermally conductive element is a tubular body with a vacuumed interior, little thermally conductive medium being filled in the tubular body.

5. The heat exchanging apparatus for increasing/decreasing dye temperature of the gas-liquid dyeing machine as claimed in claim 4, wherein the thermally conductive medium is water.

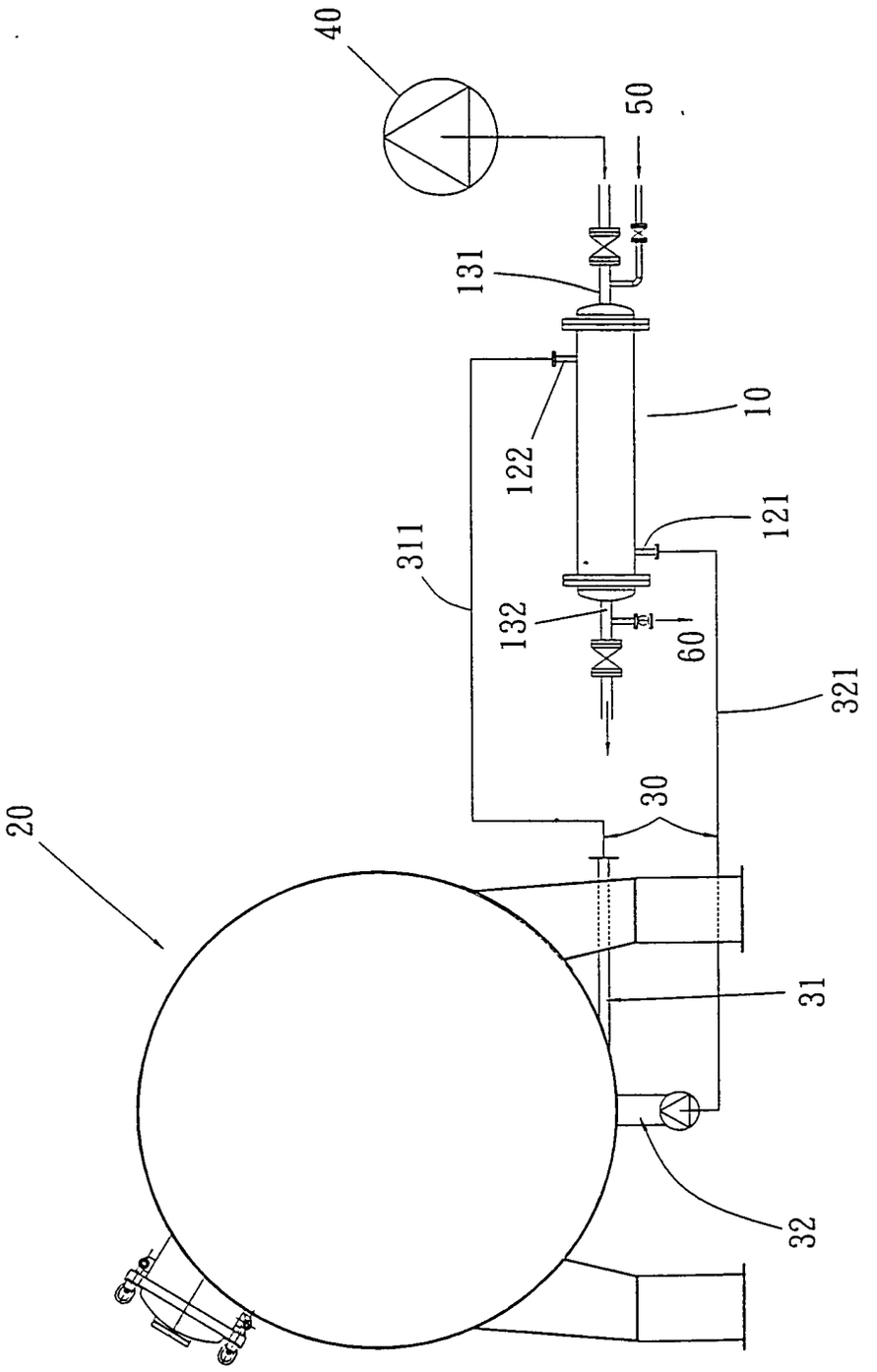


Fig. 1

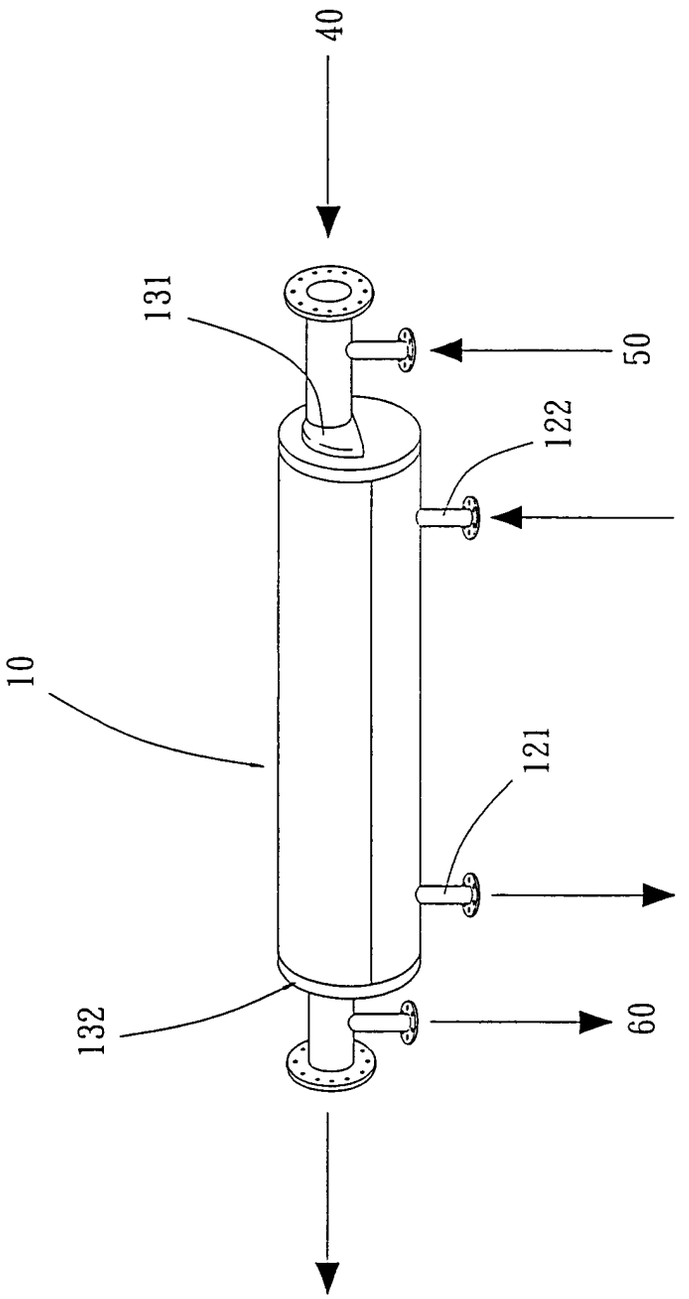


Fig. 2

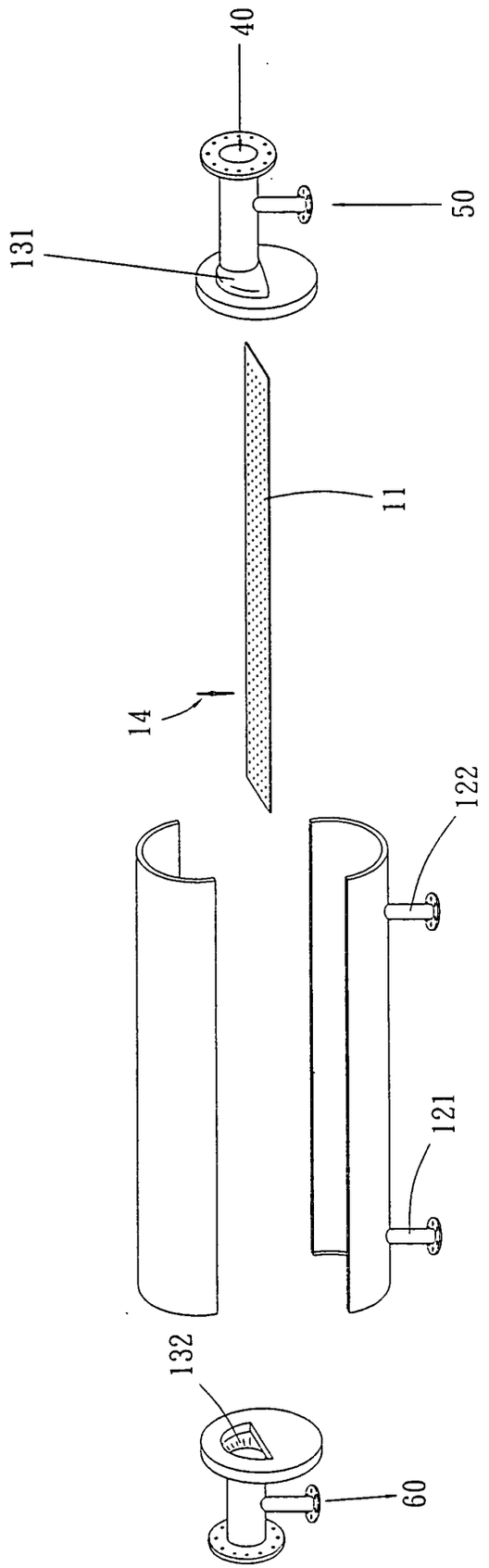


Fig. 3

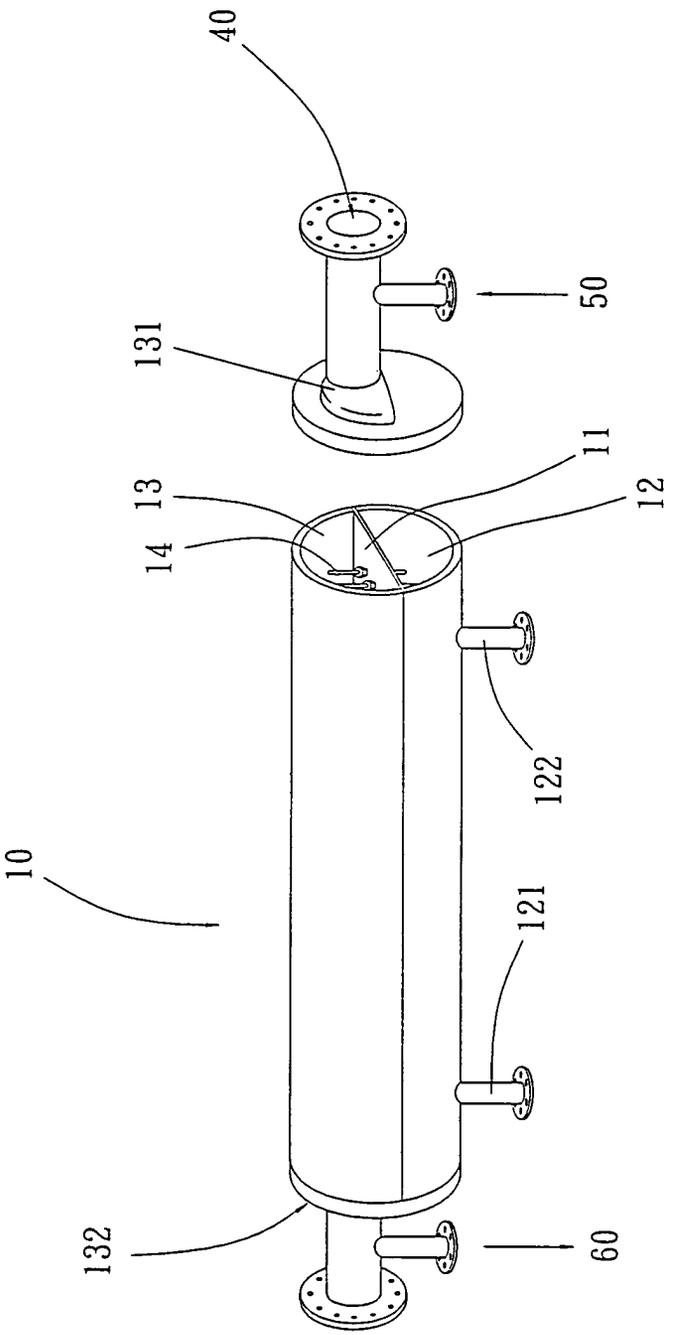


Fig. 4

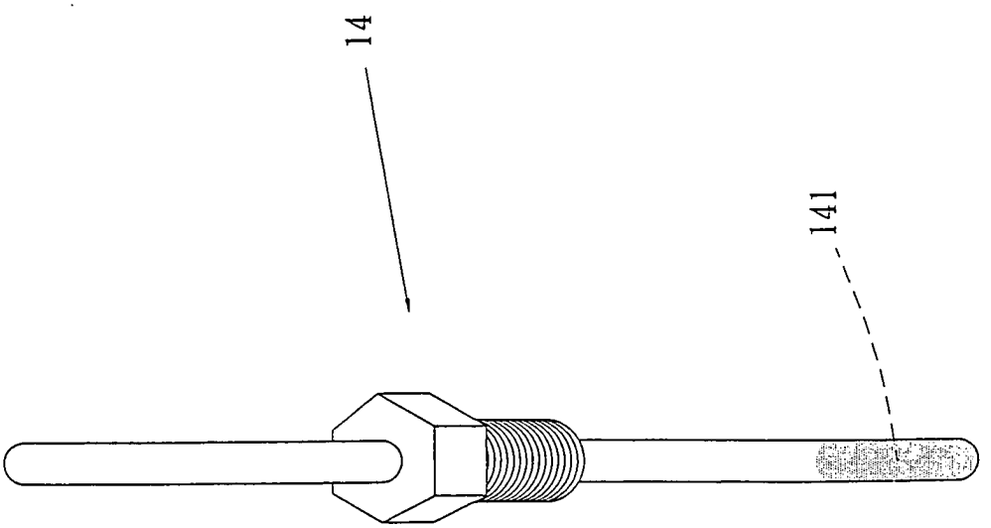


Fig. 5

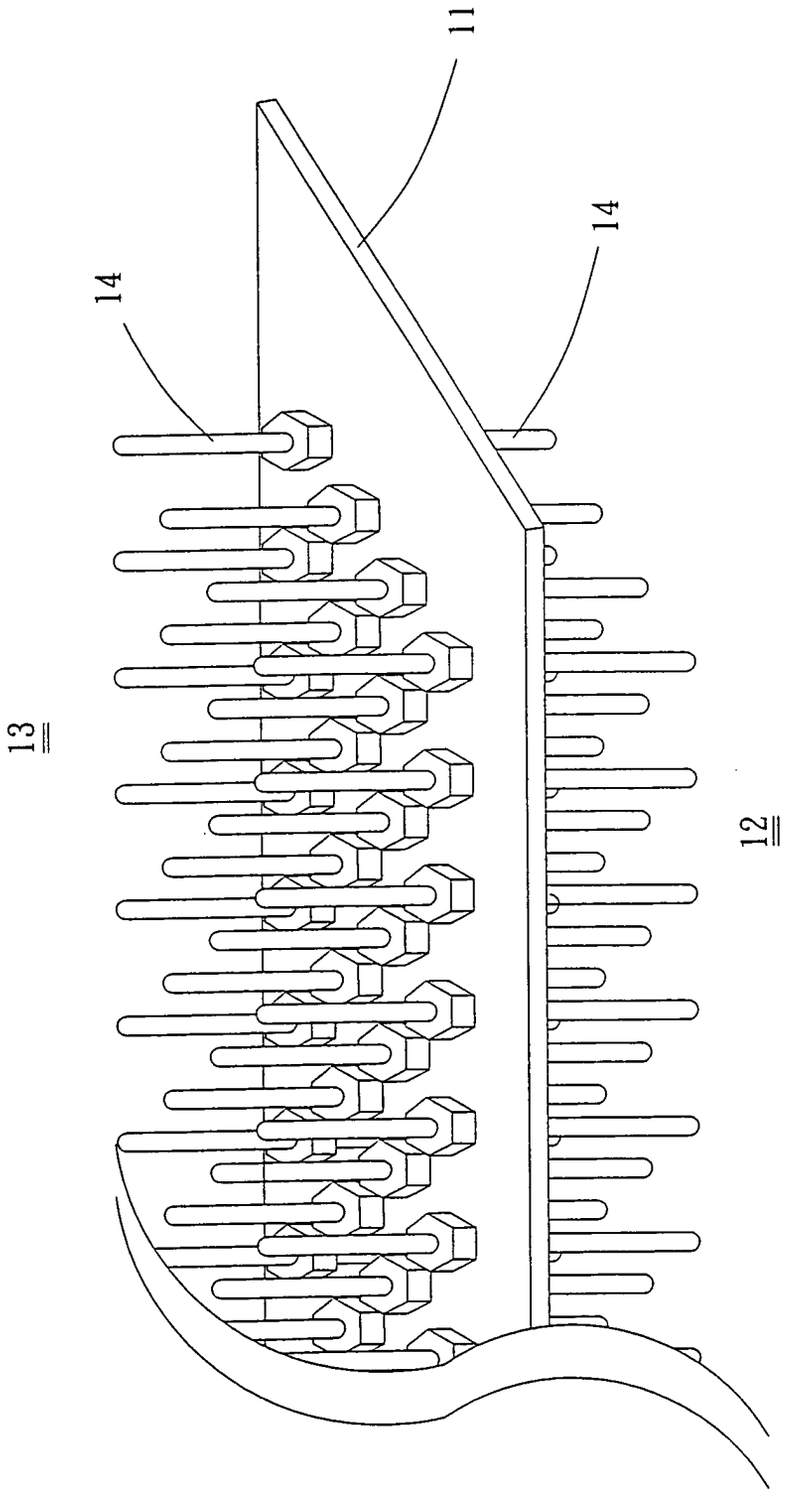


Fig. 6

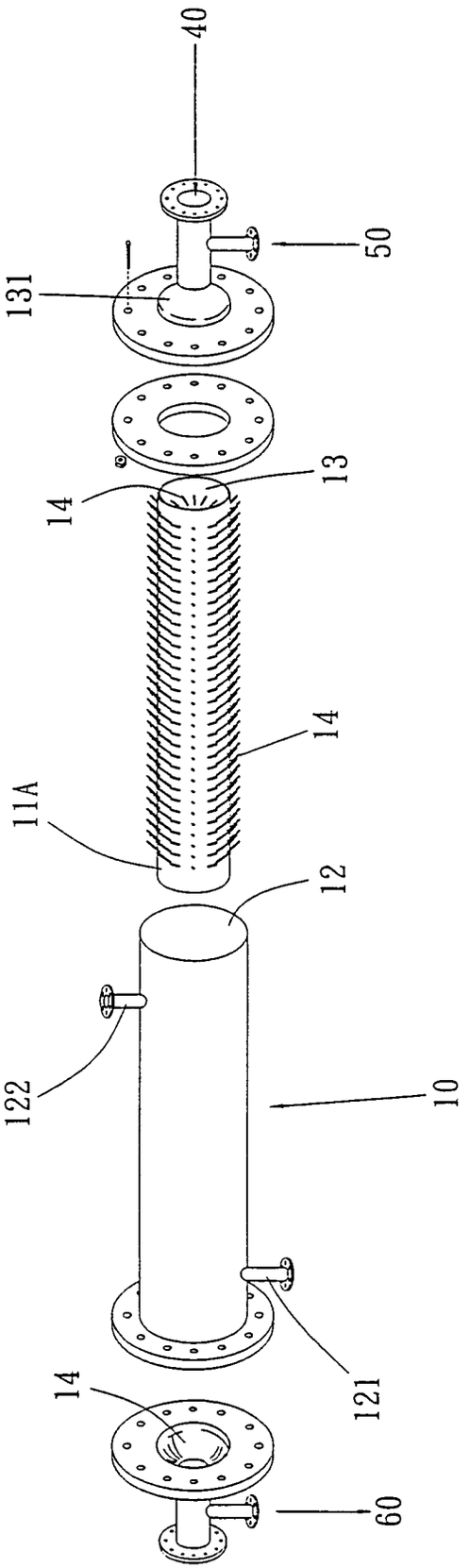


Fig. 7

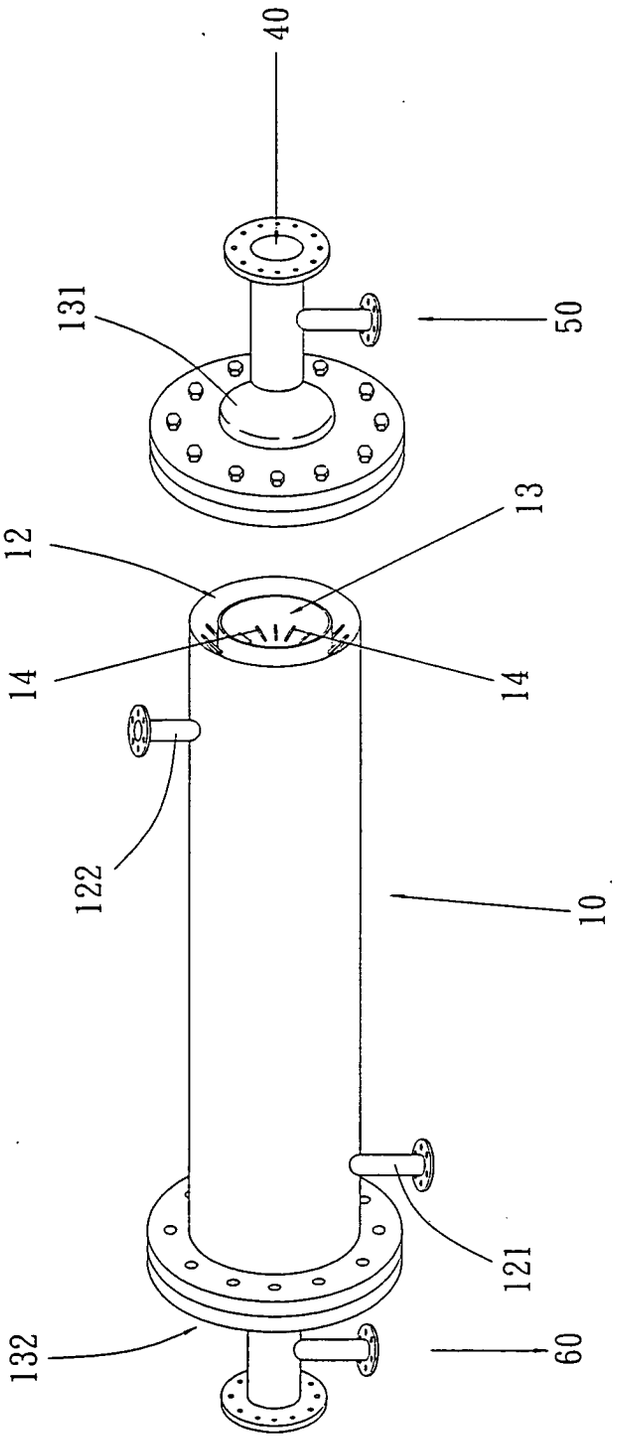


Fig. 8