

DESCRIPTION

TITLE OF THE INVENTION: HEAT-TRANSFER-TUBE SUPPORT STRUCTURE,
AND METHOD FOR SUPPORTING HEAT TRANSFER TUBE

5

TECHNICAL FIELD

[0001]

The present invention relates to a support structure for heat transfer tubes which
are arranged in a staggered manner in heat-transfer-tube panels provided in a heat recovery
10 steam generator etc., and a method for supporting such a heat transfer tube.

BACKGROUND ART

[0002]

In a combined power plant which has drawn attention as a part of high
efficiency power generation, electric power is first generated using a gas turbine. At the
15 same time, heat in exhaust gas discharged from the gas turbine is recovered in a heat
recovery steam generator (HRSG), and a steam turbine is driven by steam generated by the
heat recovery steam generator to thereby generate electric power. Since the combined
power plant can perform the power generation using the gas turbine and the power
generation using the steam turbine simultaneously, the combined power plant is high in
20 efficiency of the power generation. In addition thereto, there is also an advantage that the
gas turbine is excellent in load responsiveness and can also satisfactorily respond to a
sudden increase in electric power demand.

[0003]

Inside the heat recovery steam generator in this type of combined power plant,
25 heat exchangers such as a superheater, an evaporator and a coal economizer which recover
the heat of the exhaust gas of the gas turbine are generally disposed, and a denitrification
device is also disposed in order to denitrify the exhaust gas. The heat exchangers are
constituted by heat-transfer-tube panels in each of which a large number of heat transfer
tubes standing erectly in an up/down direction are arranged in a staggered manner. In
30 order to make it easy to absorb the heat from the exhaust gas, fin-including heat transfer
tubes having fins spirally wound therearound have been widely used.

[0004]

In the heat recovery steam generator which is called horizontal type and which has a configuration in which the exhaust gas flows in a horizontal direction toward the heat-transfer-tube panels, a duct has a height of 20 meters or more to be large-sized due to an increase in size of the steam generator caused by an increase in size of the gas turbine.

5 The fin-including heat transfer tubes inside the duct also become long accordingly.
[0005]

It has been known that the fin-including heat transfer tubes vibrate due to fluid force of the exhaust gas, a Karman vortex street occurring in a flow behind the fin-including heat transfer tubes, etc. Particularly, when the fin-including heat transfer tubes are elongated, the fins of the adjacent heat transfer tubes tend to damage each other due to the vibration. To solve this problem, there has been heretofore proposed a technique in which the fin-including heat transfer tubes disposed in the staggered manner are bundled in the horizontal direction by support members, and the support members are provided in a plurality of stages at predetermined intervals in a vertical direction of the heat-transfer-tube panel, thereby suppressing the vibration of the fin-including heat transfer tubes.
15 [0006]

For example, PTL 1 describes a heat-transfer-tube support structure which is configured in such a manner that fin-including heat transfer tubes disposed in a staggered manner are supported by plate-like support members inserted between fins, linking plates are inserted into oblique gaps between the fin-including heat transfer tubes, and opposite ends of each of the linking plates are fixed respectively to ones of the support members of heat-transfer-tube panels adjacent to each other in a front/rear direction along a flowing direction of exhaust gas, thereby enhancing rigidity of the heat-transfer-tube panels as a whole.
20 [0007]

Moreover, PTL 2 describes a heat-transfer-tube support structure which is configured in such a manner that fin-including heat transfer tubes disposed in a staggered manner are supported by honeycomb-shaped support members, several ones of the fin-including heat transfer tubes positioned on horizontally opposite end sides are supported by short reinforcing support members, and the support members and the reinforcing support members are linked to each other by gate-type opening prevention plates inserted into oblique gaps between the fin-including heat transfer tubes, thereby reducing vibration displacement of a heat-transfer-tube panel.
30

CITATION LIST

PATENT LITERATURE

[0008]

PTL 1: Japanese Patent No. 2857440

5 PTL 2: JP-A-2013-57468

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0009]

10 In recent gas turbine specifications, exhaust gas arriving at a heat recovery steam generator is high in temperature and flow rate and swirls. Therefore, there is a higher possibility that vibration of heat-transfer-tube panels is so intense to cause damage to support members by which fin-including heat transfer tubes are bundled in a horizontal direction and damage to fins of the heat transfer tubes.

[0010]

15 However, the heat-transfer-tube support structure described in PTL 1 is a technique in which the linking plates are inserted into the oblique gaps between the fin-including heat transfer tubes positioned on the horizontally opposite end sides, and the opposite ends of each of the linking plates are fixed to the support members of the heat-transfer-tube panels so as to enhance rigidity of the panels. The rigidity on the opposite
20 end sides of the support members is enhanced to some degree by the linking plates. However, since it does not mean that the rigidity of the support members as a whole can be enhanced, it is difficult to suppress damage to any part of the support members and damage to any part of the fins of the heat transfer tubes.

[0011]

25 In addition, the heat-transfer-tube support structure described in PTL 2 is a technique in which the reinforcing support members are added to make the opposite end sides of each of the support members wider in width than a central portion thereof so as to reduce the vibration displacement of the heat-transfer-tube panel by use of phase differences among three vibration systems (a panel left end portion vibration system, a
30 panel central portion vibration system and a panel right end portion vibration system). The opening prevention plates inserted into the oblique gaps between the fin-including heat transfer tubes serve for preventing the reinforcing support members and the support member from being separated from each other. Since it does not mean that the rigidity of

the support member as a whole can be enhanced by the opening prevention plates, it is difficult to suppress damage to any part of the support member and damage to any part of fins of the heat transfer tubes.

[0012]

5 The present invention has been accomplished in consideration of such actual situations of the background art. An object of the present invention is to provide a heat-transfer-tube support structure in which damage to any part of support members and damage to any part of fins of heat transfer tubes caused by vibration of a heat-transfer-tube panel can be suppressed, and another object of the present invention is to provide a method
10 for supporting such a heat-transfer-tube support structure.

SOLUTION TO PROBLEM

[0013]

In order to achieve the aforementioned object, the representative present invention provides a heat-transfer-tube support structure including: a heat-transfer-tube panel in
15 which a plurality of heat transfer tubes extending in a vertical direction are arranged in a staggered manner; and support members that bundle the heat transfer tubes in a horizontal direction, and that are provided in a plurality of stages at predetermined intervals in the vertical direction of the heat-transfer-tube panel; wherein: the heat-transfer-tube support structure further includes: first reinforcing plates that are obliquely disposed in gaps
20 between the heat transfer tubes; second reinforcing plates that are obliquely disposed in the gaps so as to intersect the first reinforcing plates; and linking members that fix one-end sides of the first reinforcing plates and the second reinforcing plates to the support members respectively.

ADVANTAGEOUS EFFECTS OF INVENTION

25 [0014]

According to the present invention, damage to any part of the support members and damage to any part of fins of the heat transfer tubes caused by vibration of the heat-transfer-tube panel can be suppressed. Incidentally, other problems, configurations and effects than the aforementioned ones will be made clear by the following description of
30 embodiments.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

[FIG. 1] An explanatory view showing a schematic system of a combined power plant.

[FIG. 2] A perspective view of external appearance of a heat recovery steam generator.

[FIG. 3] A side view showing an internal structure of an inlet portion of the heat recovery steam generator.

[FIG. 4] A perspective view of each heat-transfer-tube panel provided in the heat recovery steam generator.

[FIG. 5] A cross-sectional view of the heat-transfer-tube panel.

[FIG. 6] A perspective view of a heat-transfer-tube support structure according to an embodiment of the present invention.

[FIG. 7] A front view of the heat-transfer-tube support structure.

[FIG. 8] A plan view of the heat-transfer-tube support structure.

[FIG. 9] An explanatory view of a main part of the heat-transfer-tube support structure.

[FIGS. 10] Explanatory views showing an assembling procedure of the heat-transfer-tube support structure.

[FIG. 11] A perspective view of a heat-transfer-tube support structure according to another embodiment of the present invention.

[FIG. 12] A perspective view of a heat-transfer-tube support structure according to a further embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0016]

Embodiments of the present invention will be described below with reference to FIG. 1 to FIG. 12.

[0017]

FIG. 1 is an explanatory view showing a schematic system of a combined power plant. As shown in FIG. 1, high-temperature high-flow-rate exhaust gas 11 emitted from a gas turbine 1 sequentially makes contact with a superheater 3, a first evaporator 4, a denitrification device 5, a second evaporator 6, and a coal economizer 7 to be thermally exchanged therewith. The superheater 3, the first evaporator 4, the denitrification device 5, the second evaporator 6, and the coal economizer 7 are placed inside a duct 12 of a heat recovery steam generator (HRSG) 2. In addition, water containing steam from each of the first evaporator 4 and the second evaporator 6 is sent through a pipeline 9a or a pipeline 9b to a steam separator drum 8. After the steam separated from the steam separator drum 8 passes through a saturated steam pipe 10 to be further superheated by the superheater 3,

the steam passes through a main steam pipe 13 to be used as superheated steam driving a steam turbine 14.

[0018]

The steam used by the steam turbine 14 is converted back into water W by a
5 condenser 15, circulated to the coal economizer 7 by a water feed pump 17 disposed in a
water feed pipeline 16, preheated by the exhaust gas 11 emitted from the gas turbine 1 in
the coal economizer 7, and fed into the steam separator drum 8. Water inside the steam
separator drum 8 flows down through a water downflow pipe 18, and passes through
pipelines 19a and 19b to be guided into the evaporators 4 and 6. Then, the water returns
10 into the steam separator drum 8 via the pipelines 9a and 9b. A turbine bypass pipe 20
connected to the main steam pipe 13 may bypass the steam turbine 14 to guide steam
directly to the condenser 15. In addition, a steam turbine control valve 21 for adjusting a
flow rate of steam into the steam turbine 14, a turbine bypass valve 22 for adjusting a
bypass rate of steam by feed of the stream into the steam turbine 14, and a damper 23 of
15 the duct 12 are provided.

[0019]

The outline of the respective flows of the high-temperature high-flow-rate exhaust
gas 11, the water feed, and the steam in the combined power plant have been described
above. However, inside the duct 12 of the heat recovery steam generator 2, heat
20 exchangers such as the superheater 3, the evaporators 4 and 6, and the coal economizer 7
are generally incorporated to recover waste heat of the exhaust gas 11, and the
denitrification device 5 is disposed in order to denitrify the exhaust gas 11.

[0020]

FIG. 2 is a perspective view of external appearance of the heat recovery steam
25 generator 2. In FIG. 2, the duct 12 is shown with a portion being broken so as to make an
internal structure of the heat recovery steam generator 2 visible. FIG. 3 is a side view
showing the internal structure of an inlet portion of the heat recovery steam generator 2.

[0021]

As shown in FIG. 2 and FIG. 3, the duct 12 of the heat recovery steam generator 2
30 is supported on a ground 25 through a frame 24. The high-temperature high-flow-rate
exhaust gas 11 emitted from the gas turbine 1 flows into the duct 12. The exhaust gas 11
flowing into the duct 12 is thermally absorbed by heat-transfer-tube panels 30. The gas
whose temperature has changed to be relatively low is discharged to the outside of the duct

12 from a smokestack 26. The heat-transfer-tube panels 30 are supported to be hung from headers 27 so as to serve as heat exchangers constituting heat transfer faces for the superheater 3, the first evaporator 4, the second evaporator 6, the coal economizer 7, etc. shown in FIG. 1. The high-temperature high-flow-rate exhaust gas 11 acts on the heat-transfer-tube panels 30. Accordingly, the heat-transfer-tube panels 30 vibrate both in a front/rear direction and in a left/right direction against a gas flow.

[0022]

FIG. 4 is a perspective view of each heat-transfer-tube panel 30. FIG. 5 is a cross-sectional view of the heat-transfer-tube panel 30. As shown in FIG. 4 and FIG. 5, the heat-transfer-tube panel 30 has a large number of heat transfer tubes 31 connected between upper and lower headers 27. Fins 32 for making it easy to absorb the heat from the exhaust gas 11 are spirally wound around outer circumferential faces of the heat transfer tubes 31. In the present embodiment, three heat-transfer-tube panels 30 are set as one unit in a direction in which panel faces thereof are disposed perpendicularly to the gas flow, and such units are arranged side by side.

[0023]

The heat transfer tubes 31 including the fins 32 (hereinafter referred to as fin-including heat transfer tubes) are disposed in a staggered manner with three rows. The fin-including heat transfer tubes 31 are bundled in a horizontal direction by use of a honeycomb support 33 and a horizontal support 34. The honeycomb support 33 is formed in such a manner that corrugated plates disposed so as to hold the fins 32 therebetween are made to abut against each other, and integrated in a honeycomb shape. The fin-including heat transfer tubes 31 disposed in the staggered manner are linked to one another in the horizontal direction by the honeycomb support 33. The horizontal support 34 is weld-connected to the circumference of the honeycomb support 33. One support member 35 is constituted by the honeycomb support 33 and the horizontal support 34. Such support members 35 are provided in a plurality of stages (e.g. nine stages) at predetermined intervals in the vertical direction of the heat-transfer-tube panel 30. The fin-including heat transfer tubes 31 which are, for example, arranged in 3 rows each including 33 tubes are bundled at a plurality of vertical places in the horizontal direction by the support members 35.

[0024]

The heat-transfer-tube panels 30 bundled thus by the support members 35 are set inside the duct 12 of the heat recovery steam generator 2. As described above, the high-temperature high-flow-rate exhaust gas 11 acts on the heat-transfer-tube panels 30.

Accordingly, there is a possibility that the heat-transfer-tube panels 30 vibrate intensely both in the front/rear direction and in the left/right direction against the gas flow, thereby causing damage to the support members 35 and damage to the fins 32. As a countermeasure structure against the possibility, the present invention uses a heat-transfer-tube support structure which will be described below.

[0025]

FIG. 6 is a perspective view of the heat-transfer-tube support structure according to an embodiment of the present invention. FIG. 7 is a front view of the heat-transfer-tube support structure. FIG. 8 is a plan view of the heat-transfer-tube support structure. FIG. 9 is an explanatory view of a main part of the heat-transfer-tube support structure. Incidentally, in FIG. 6 and FIG. 7, the fin-including heat transfer tubes 31 are schematically shown while the fins 32 are omitted.

[0026]

As shown in FIG. 6 to FIG. 9, of the fin-including heat transfer tubes 31 disposed in the staggered manner with the three rows, each of the fin-including heat transfer tubes 31 disposed on a front side (most upstream side of the gas flow) facing the inlet of the duct 12 is mounted with cylindrical protection members 36 respectively at two upper and lower places between which the support member 35 is held. Each protection member 36 is formed out of divided pieces that are disposed around a corresponding one of the fins 32 and welded with each other into a cylindrical shape. Each pair of the protection members 36 which abut against a corresponding part of the honeycomb support 33 from above and below are weld-bonded to the part of the honeycomb support 33 on their abutting portions respectively, and formed into an upper/lower paired structure by an attachment piece 37. When such protection members 36 are attached to the installed heat-transfer-tube panel 30, the heat transfer tubes 31 can be protected by the protection members 36 so as not to make contact with the honeycomb supports 33 even if the fins 32 are chipped due to the vibration of the honeycomb supports 33.

[0027]

First reinforcing plates 38 are inserted in an oblique left direction into gaps between the fin-including heat transfer tubes 31 disposed in the staggered manner, and

second reinforcing plates 39 are inserted in an oblique right direction into the gaps so as to intersect the first reinforcing plates 38. The first reinforcing plates 38 are supported on the honeycomb support 33. The second reinforcing plates 39 are supported on the first reinforcing plates 38 in the intersecting state therewith.

5 [0028]

As shown in FIG. 9, each of the first reinforcing plates 38 is formed into a T-shape having a pair of notches 38a. The first reinforcing plate 38 is placed on the honeycomb support 33 in a state in which one of the notches 38a has avoided abutment against a corresponding one of the protection members 36. Accordingly, the first reinforcing plate
10 38 can be stably supported on the honeycomb support 33. Incidentally, the first reinforcing plate 38 may be formed into a shape having only one notch 38a. When the first reinforcing plate 38 has the T-shape having the two notches 38a, the protection member 36 can be surely received in one of the notches 38a even if the first reinforcing plate 38 is inserted in any direction, that is, from the front or from the rear. Accordingly,
15 assembling workability can be improved.

[0029]

Each of the second reinforcing plates 39 is formed into an I-shape with a uniform width. The length of the second reinforcing plate 39 is substantially equal to that of the first reinforcing plate 38. In the case of the present embodiment, the first reinforcing
20 plates 38 and the second reinforcing plates 39 are inserted in the intersecting state into all the gaps between the fin-including heat transfer tubes 31 disposed in the staggered manner with the three rows. Accordingly, one first reinforcing plate 38 intersects three second reinforcing plates 39, and one second reinforcing plate 39 intersects three first reinforcing plates 38.

25 [0030]

One-end sides of the first reinforcing plates 38 and the second reinforcing plates 39 protrude outward from the horizontal support 34 in the intersecting state. Flat plate-like linking members 40 are inserted between the first reinforcing plates 38 and the second reinforcing plates 39. The first reinforcing plates 38 and the second reinforcing plates 39
30 are weld-connected to opposite side portions of the linking members 40, and the linking members 40 are weld-bonded to the horizontal support 34. Thus, the one-end sides of the first reinforcing plates 38 and the second reinforcing plates 39 adjacent to each other are

fixed to the support member 35 (horizontal support 34) through the linking members 40 shared by the first reinforcing plates 38 and the second reinforcing plates 39.

[0031]

In the heat-transfer-tube support structure according to the present embodiment, as
5 described above, a structure in which the first reinforcing plate 38, the second reinforcing plate 39, and the linking member 40 are bonded into a triangular shape is formed over the entire range of the support member 35. Accordingly, the fin-including heat transfer tubes 31 in all the rows can be made rigid. Even when the heat-transfer-tube panel 30 vibrates intensely in the front/rear direction and the left/right direction, damage to the support
10 member 35 and damage to the fins 32 can be suppressed. Incidentally, such a heat-transfer-tube support structure is preferably applied to all the support members 35 provided in the stages in the up/down direction of the heat-transfer-tube panel 30. However, the support member 35 in any stage, e.g. the support member 35 on each of the opposite upper and lower end sides may be omitted. In addition, the protection members 36 may be
15 omitted. In this case, both the first reinforcing plates 38 and the second reinforcing plates 39 may be formed into the I-shape.

[0032]

Next, an assembling procedure of the heat-transfer-tube support structure configured in the aforementioned manner will be described with reference to FIGS. 10.

20 [0033]

In each of the installed heat-transfer-tube panels 30 disposed inside the duct 12, the fin-including heat transfer tubes 31 disposed in the staggered manner with the three rows are bundled in the horizontal direction by the support members 35 each including the honeycomb support 33 and the horizontal support 34, and such support members 35 are
25 provided in the stages in the up/down direction of the heat-transfer-tube panel 30.

[0034]

In the heat transfer tube supporting method according to the present embodiment, first, each of the fin-including heat transfer tubes 31 in the first row disposed on the front side (the most upstream side of the gas flow) of the heat-transfer-tube panel 30 is mounted
30 with the protection members 36 respectively at the two upper and lower places between which the support member 35 is held, as shown in FIG. 10(a). Then, each pair of the protection members 36 which abut against a corresponding part of the honeycomb support 33 from above and below are weld-bonded to the part of the honeycomb support 33 on

their abutting portions respectively, and formed into the upper/lower paired structure by the attachment piece 37.

[0035]

Next, as shown in FIG. 10(b), the first reinforcing plates 38 are inserted into the gaps between the fin-including heat transfer tubes 31 from the front side of the heat-transfer-tube panel 30, and the first reinforcing plates 38 are disposed in the oblique left direction in the gaps between the fin-including heat transfer tubes 31 disposed in the staggered manner. The pair of notches 38a are formed in each of the first reinforcing plates 38. Accordingly, the protection member 36 is received in one of the notches 38a. Thus, the first reinforcing plate 38 can be stably placed on the honeycomb support 33. In addition, an insertion amount of the first reinforcing plate 38 is defined by the notch 38a and the protection member 36. Accordingly, the one-end side of the first reinforcing plate 38 can be protruded outward by a predetermined amount from the horizontal support 34.

[0036]

Next, as shown in FIG. 10(c), the second reinforcing plates 39 are inserted into the gaps between the fin-including heat transfer tubes 31 so as to intersect the first reinforcing plates 38, and the second reinforcing plates 39 are superimposed on the first reinforcing plates 38 to be disposed in the oblique right direction in the gaps between the fin-including heat transfer tubes 31. On this occasion, each of the one-end sides of the second reinforcing plates 39 is protruded outward from the horizontal support 34 by the same amount as the first reinforcing plate 38.

[0037]

Next, the linking members 40 are fitted between the first reinforcing plates 38 and the second reinforcing plates 39 protruding from the horizontal support 34. The first reinforcing plates 38 and the second reinforcing plates 39 are weld-connected to the linking members 40, and the linking members 40 are weld-bonded to the horizontal support 34. Thus, the one-end sides of the first reinforcing plates 38 and the second reinforcing plates 39 are fixed to the support member 35 through the linking members 40, as shown in FIG. 7.

[0038]

According to the heat transfer tube supporting method according to the present embodiment as described above, in the installed heat-transfer-tube panel 30 in which the fin-including heat transfer tubes 31 have been bundled in the horizontal direction by the

support members 35, the first reinforcing plates 38 and the second reinforcing plates 39 are inserted into the gaps between the fin-including heat transfer tubes 31 from the panel's front side where a working space can be secured. Thus, the structure in which the first reinforcing plate 38, the second reinforcing plate 39 and the linking member 40 are bonded
5 into a triangular shape can be formed easily over the entire ranges of the support members 35. As a result, the fin-including heat transfer tubes 31 in all the rows can be made rigid. Accordingly, even when the heat-transfer-tube panel 30 has vibrated intensely in the front/rear direction and the left/right direction, damage to the support members 35 and damage to the fins 32 can be suppressed.

10 [0039]

Incidentally, the heat-transfer-tube panel 30 including the fin-including heat transfer tubes 31 disposed in the staggered manner with the three rows has been described in the aforementioned embodiment. However, the number of rows of the fin-including heat transfer tubes 31 disposed in the staggered manner may be two or four or more. In
15 addition, the shapes or the fixation methods of the first reinforcing plates 38 and the second reinforcing plates 39 are not limited to those described in the aforementioned embodiment but can be changed suitably according to the staggered arrangement of the fin-including heat transfer tubes 31, presence/absence of the protection members 36, etc.

[0040]

20 FIG. 11 is a perspective view of a heat-transfer-tube support structure according to another embodiment of the present embodiment. FIG. 11 shows an application example of the heat-transfer-tube support structure to a heat-transfer-tube panel in which fin-including heat transfer tubes 31 are disposed in a staggered manner with two rows but not mounted with any protection member 36.

25 [0041]

As shown in FIG. 11, first reinforcing plates 41 whose front sides are bent into curved shapes are obliquely inserted into gaps under a honeycomb support 33 between the fin-including heat transfer tubes 31 disposed in the staggered manner with the two rows. The front sides of the first reinforcing plates 41 are fixed to the honeycomb support 33
30 through linking members 42. In addition, second reinforcing plates 43 whose rear sides are bent into curved shapes are obliquely inserted into the gaps above the honeycomb support 33 between the fin-including heat transfer tubes 31 so as to intersect the first

reinforcing plates 41. Front sides of the second reinforcing plates 43 are fixed to the honeycomb support 33 through other linking members 44.

[0042]

FIG. 12 is a perspective view of a heat-transfer-tube support structure according to a further embodiment of the present invention. FIG. 12 shows an application example of the heat-transfer-tube support structure to a heat-transfer-tube panel in which fin-including heat transfer tubes 31 are disposed in a staggered manner with two rows and mounted with protection members 36.

[0043]

As shown in FIG. 12, the protection members 36 each shaped like a cylinder are mounted on the fin-including heat transfer tubes 31 disposed in the staggered manner with the two rows, and the protection members 36 are weld-connected to a honeycomb support 33. First reinforcing plates 41 whose front sides are bent into curved shapes are obliquely inserted into gaps below the honeycomb support 33 between the fin-including heat transfer tubes 31, and the front sides of the first reinforcing plates 41 are fixed to outer circumferential faces of the protection members 36 through linking members 42. In addition, second reinforcing plates 43 whose rear sides are bent into curved shapes are obliquely inserted into gaps above the honeycomb support 33 between the fin-including heat transfer tubes 31 so as to intersect the first reinforcing plates 41. Front sides of the second reinforcing plates 43 are fixed to the outer circumferential faces of the protection members 36 through other linking members 44.

[0044]

Incidentally, the present invention is not limited to the aforementioned embodiments but can include various modifications. For example, the aforementioned embodiments have been described in detail in order to explain the present invention in a manner easy to understand. The aforementioned embodiments are however not always limited to the heat-transfer-tube support structures including all the constituents which have been described.

REFERENCE SIGNS LIST

[0045]

- 1 gas turbine
- 2 heat recovery steam generator
- 11 exhaust gas

	12	duct
	27	header
	30	heat-transfer-tube panel
	31	heat transfer tube (fin-including heat transfer tube)
5	32	fin
	33	honeycomb support (support member)
	34	horizontal support (support member)
	35	support member
	36	protection member
10	37	attachment piece
	38, 41	first reinforcing plate
	38a	notch
	39, 43	second reinforcing plate
	40, 42, 44	linking member

CLAIMS

1. A heat-transfer-tube support structure comprising: a heat-transfer-tube panel in which a plurality of fin-including heat transfer tubes extending in a vertical direction and
5 having fins mounted on outer circumferential portions thereof are arranged in a staggered manner; and support members that bundle the fin-including heat transfer tubes in a horizontal direction, and that are provided in a plurality of stages at predetermined intervals in the vertical direction of the heat-transfer-tube panel; wherein:
 - the heat-transfer-tube support structure further comprises:
 - 10 first reinforcing plates that are obliquely disposed in gaps between the fin-including heat transfer tubes;
 - second reinforcing plates that are obliquely disposed in the gaps between the heat transfer tubes so as to intersect the first reinforcing plates;
 - linking members through which one-end sides of the first reinforcing plates and
15 the second reinforcing plates are fixed to the support members respectively; and
 - cylindrical protection members that surround the fin-including heat transfer tubes;
 - and
 - the cylindrical protection members are fixed to the support members.
- 20 2. A heat-transfer-tube support structure according to Claim 1, wherein:
 - the first reinforcing plates and the second reinforcing plates are fixed to the support members through the linking members shared by the first reinforcing plates and the second reinforcing plates.
- 25 3. A heat-transfer-tube support structure according to Claim 1, wherein:
 - notches avoiding abutment against the cylindrical protection members are formed in either the first reinforcing plates or the second reinforcing plates.
4. A method for supporting a heat transfer tube, which method is performed on a
30 heat recovery steam generator in which a heat-transfer-tube panel including a plurality of fin-including heat transfer tubes is provided and disposed inside a duct into which exhaust gas emitted from a gas turbine is made to flow, the fin-including heat transfer tubes extending in a vertical direction and having fins mounted on outer circumferential portions

thereof, the fin-including heat transfer tubes being arranged in a staggered manner with a plurality of rows and bundled in a horizontal direction by support members, the support members being provided in a plurality of stages at predetermined intervals in the vertical direction of the heat-transfer-tube panel, the method comprising the steps of:

- 5 mounting cylindrical protection members on each of the fin-including heat transfer tubes disposed in a row on a most upstream side of a gas flow in the heat-transfer-tube panel, so that the cylindrical protection members hold a corresponding one of the support members therebetween from above and from below respectively, and fixing the cylindrical protection members to the support members;
- 10 obliquely inserting first reinforcing plates into gaps between the fin-including heat transfer tubes;
 - obliquely inserting second reinforcing plates into the gaps so as to intersect the first reinforcing plates; and
 - fixing one-end sides of the first reinforcing plates and one-end sides of the second
- 15 reinforcing plates to the support members through linking members respectively.