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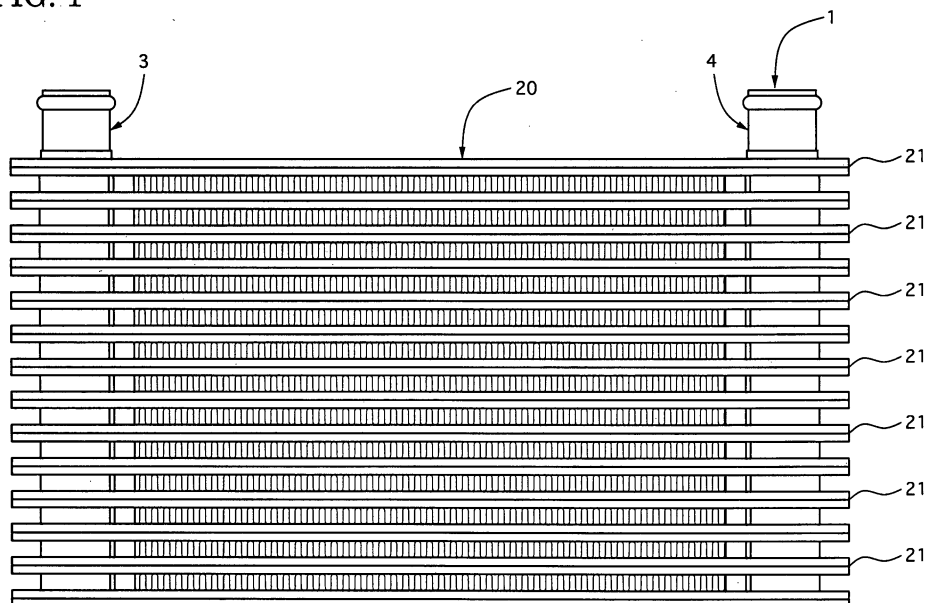
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(54) **STRUCTURE OF PROTECTIVE MEMBER FOR VEHICLE HEAT EXCHANGER**

(57) A protect structure, of a heat exchanger (1) for a motor vehicle, includes a core part (2) of the heat exchanger (1) and a protect member (20). The core part (2) has a plurality of tubes (5) and fins (6) that are alternately arranged with each other, and the protect member (20) is provided at a front side of the core part (2). The

protect member (20) has a plurality of protecting portions (21: 30) extending in a longitudinal direction of the tubes (5) to cover front sides of the tubes (5) of the core part (2) and avoid a collision between the core part (2) and an attack object (X) that is flown from an oblique front side of the motor vehicle toward the core part (2).

FIG. 1



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Description**[TECHNICAL FIELD]**

[0001] The present invention relates to a protecting structure of a heat exchanger for a motor vehicle.

[BACKGROUND OF THE INVENTION]

[0002] A conventional protecting structure of a heat exchanger for a motor vehicle is disclosed in Japanese Patent Application Laid-Open Publication No. 2000 - 52752. This conventional protecting structure is provided with a protect member which is arranged in front of a core part having a plurality of tubes and fins, which are arranged alternately with each other, in order to protect the tubes from being attacked by a foreign body such as a rock flying from the outside of the core part.

[DISCLOSURE OF THE INVENTION]**[PROBLEM(S) TO BE SOLVED BY THE INVENTION]**

[0003] The conventional protecting structure, however, has a problem in that, since the protect member is composed of a plurality of louvers, an attack object, which is flown obliquely upward along an inclined angle of the louvers from a front side of the motor vehicle, might pass through a clearance formed between the louvers and be collided with the tubes.

[0004] The present invention is made in order to solve the above-described problem, and its object is to provide a protect structure of a heat exchanger for a motor vehicle that can surely protect each tube by avoiding a collision between a core part and an attack object flying to the core part from an oblique front side of the motor vehicle.

[MEANS FOR SOLVING THE PROBLEMS]

[0005] According to an aspect of the present invention there is provided a protect structure, of a heat exchanger for a motor vehicle, including a core part of the heat exchanger and a protect member. The core part has a plurality of tubes and fins that are alternately arranged with each other, and the protect member is provided at a front side of the core part. The protect member has a plurality of protecting portions extending in a longitudinal direction of the tubes to cover front sides of the tubes of the core part and avoid a collision between the core part and an attack object that is flown from an oblique front side of the motor vehicle toward the core part.

[EFFECT OF THE INVENTION]

[0006] In the protect structure of the heat exchanger for the motor vehicle of the present invention, the core part has the plurality of tubes and fins that are alternately arranged with each other, and the protect member is pro-

vided at the front side of the core part. The protect member has the plurality of protecting portions extending in the longitudinal direction of the tubes to cover front sides of the tubes of the core part and avoid the collision between the core part and the attack object that is flown from the oblique front side of the motor vehicle toward the core part. Therefore, the protect structure of the present invention can surely protect the tubes by avoiding the collision between the core part and the attack object that is flown from the oblique front side of the motor vehicle toward the core part.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0007] The objects, features and advantages of the present invention will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

FIG 1 is an entire front view showing a protect structure of a heat exchanger for a motor vehicle of a first embodiment according to the present invention; FIG 2 is a right side view showing the protect structure of the heat exchanger for the motor vehicle of the first embodiment, where louvers thereof are omitted; FIG 3 is a front view showing the heat exchanger for the motor vehicle shown in FIG 1; FIG 4 is a view illustrating a tube that is used in the heat exchanger for the motor vehicle shown in FIG 1; FIG 5 is a perspective view showing an inner fin that is used in the heat exchanger for the motor vehicle shown in FIG 1; FIG 6 is a perspective view showing end portions, which are formed with a plurality of embossed portions, of shells of the tube of the heat exchanger for the motor vehicle shown in FIG 1; FIG 7 is a cross sectional side view showing an internal structure of the heat exchanger for the motor vehicle shown in FIG 1, where inner fins in the tubes are omitted; FIG 8 is a front view showing a protect member of the first embodiment that is provided on the heat exchanger for the motor vehicle shown in FIG. 1; FIG 9 is a rear view showing the protect member of the first embodiment; FIG 10 is a right side view showing the protect member of the first embodiment; FIG 11 is a cross sectional view taken along a line S11 - S11 in FIG. 8 and illustrating a plurality of protecting portions of the protect member; FIG 12 is a view illustrating an operation of the protect portions of the protect member of the first embodiment; and FIG 13 is a cross sectional view illustrating a plurality of protecting portions of a protect member of a second embodiment according to the present invention.

[DESCRIPTION OF REFERENCE NUMBERS]

[0008]

R1	inlet passage
R2	outlet passage
1	heat exchanger for a motor vehicle
2	core part
3	inlet port
4	outlet port
5, 5a, 5b	tube
6	outer fin
6a	louver
7,8	shell
7a, 8a	annularly projecting portion
9	inner fin
9a	column portion
9b	opening portion
10	embossed portion
20	protect member
21, 30	protecting portion
21 a	tip portion
21 b	rear edge portion
21 c	front end portion
21d	rear surface
22, 23	connecting portion
24	fixing portion
24a, 24b	pin

[BEST MODE FOR CARRYING OUT THE INVENTION]

[0009] The embodiments of the present invention will be described with reference to the accompanying drawings.

[0010] A first embodiment according to the present invention will be described.

FIG 1 is an entire front view showing a protect structure of a heat exchanger of the first embodiment according to the present invention, FIG 2 is a right side view showing the same, where louvers are omitted, FIG 3 is a front view showing the heat exchanger for the motor vehicle of the first embodiment, FIG 4 is a view illustrating a tube of the first embodiment, FIG 5 is a view illustrating an inner fin of the first embodiment, FIG 6 is a view illustrating embossed portions of the first embodiment, FIG. 7 is a cross sectional view illustrating an internal structure of the heat exchanger for the motor vehicle of the first embodiment, where the inner fins are omitted, FIG 8 is a front view showing a protect member of the first embodiment; FIG 9 is a rear view showing the same, FIG 10 is a right side view showing the same, FIG. 11 is a cross sectional view taken along a line S11 - S11 in FIG 8 and illustrating a cross sectional shape of protecting portions of the protect member, and FIG 12 is a view illustrating an operation of the protect structure.

[0011] As shown in FIG 1 and FIG 2, the protect structure of the heat exchanger for the motor vehicle of the first embodiment has a protect member 20 that is ar-

ranged at a front side of the heat exchanger 1.

As shown in FIG 3, the heat exchanger 1 is what is called an air-cooled type intercooler which cools a compressed intake air, by airflow generated when the motor vehicle is running and/or airflow generated by a not-shown motor fan, in order to make a sufficient effect on supercharging of the intake air. The heat exchanger 1 is provided with a core part 2, an inlet port 3 and an outlet port 4.

[0012] The core part 2 includes a plurality of tubes 5 and a plurality of outer fins 6, in which they are alternately arranged with each other. As shown in FIG 4, each tube 5 has a pair of shells 7 and 8 and an inner fin 9 which is arranged in the pair of shells 7 and 8, where is formed like a dish to be coupled with each other.

In the shells 7 and 8, two annularly projecting portions 7a are formed at each end portion, in a longitudinal direction of the shells 7 and 8, of the shell 7 to open upward, while two annularly projecting portions 8a are formed at each end portion, in a longitudinal direction of the shells 7 and 8, of the shell 8 to open downward.

[0013] The inner fin 9 employs what is called an offset fin in which a plurality of column portions 9a are arranged parallel to a longitudinal direction of the tube 5 as shown in FIG 5, and it is formed with two opening portions 9b so that the opening portions 9b are co-axial with the annularly projecting portions 7a and 7b formed on the shells 7 and 8, respectively. The inner fin 9 is not limited to the offset fin, and it may employ a corrugated fin.

In addition, as shown in FIG 6, a plurality of embossed portions 10, which are hollowed like a hemispherical shape in an inner side of the shells 7 and 8, are formed close to the annularly projecting portions 7a and 8a of the shells 7 and 8, being apart in a forward and rearward direction thereof. The inner fin 9 is positioned by the embossed portions 10 in a state where the inner fin 9 is pressed in the shells 7 and 8 by the embossed portions 10 when the shells 7 and 8 are coupled with each other. Further, as shown in FIG. 4, an outer diameter W1 of the annularly projecting portion 7a formed on the shell 7 of the tube 5 is set to be smaller than an inner diameter W2 of the annularly projecting portion 8a formed on the shell 8. This enables the core part 2 to be formed in such a way that the annularly projecting portions 8a and the annularly projecting portions 7a of the adjacent tubes 5 are coupled with each other in a state where the tubes 5 and corrugated outer fins 6 are piled up, the outer fin 6 being placed between the adjacent tubes 5 as shown in FIG 7.

[0014] An inlet port 3 and an outlet port 4, which are formed in a circular cylinder, are inserted in and fixed to the annularly projecting portions 7a formed at the both end portion of the outermost tube (a top side tube) 5a of the core part 2, while the annularly projecting portions 8a are removed from the both end portions of the outermost tube (a bottom side tube) 5b in such a way that the annularly projecting portions 8a of the outermost tube 5b is blocked.

[0015] Accordingly, an inlet passage R1 is formed so that it is fluidically communicated with the inlet port 3 and

one end portions of the tubes 5, while an outlet passage R2 is formed so that it is fluidically communicated with the outlet port 4 and the other end portions of the tubes 5.

[0016] The outer fins 6 of the heat exchanger 1 are formed with a plurality of louvers 6a, as shown in FIG 12, between top portions and bottom portions of corrugated surface thereof, respectively. The louvers 6a are not indispensable in the present invention.

[0017] All parts, which constitute the heat exchanger 1 having the protect structure of the first embodiment, are made of aluminum. At least one side portions of connecting portions of all the parts are provided with a clad layer, namely a brazing sheet, of brazing material, and then they are temporally assembled to be conveyed into a not-shown heat furnace, where the connecting portions are brazed and integrally fixed to each other.

Designs of the parts/portions of the heat exchanger 1 may be appropriately changed in detail configurations, the number thereof, positions where they are to be formed, and others.

[0018] As shown in FIG 8 to FIG 10, the protect member 20 is formed of plastic material as one unit to have a plurality of protecting portions 21 and two connecting portions 22 and 23, where the protecting portions 21 have the same length in a longitudinal direction of the core part 2 of the heat exchanger 1 as that of the core part 2, and the connecting portions 22 and 23 connect both end portions of the protecting portions 21 in an upward and downward direction.

[0019] As shown in FIG 2, the protecting portions 21 are installed at positions corresponding to the tubes 5 of the core part 2 of the heat exchanger 1, respectively. The protecting portions 21 are formed to have a cross section formed in an approximately triangular shape, which is converged toward the front side of the motor vehicle to have a tip portion 21a at the front side thereof as shown in FIG 11. Due to this shape, an opening length W3, in the upward and downward direction, between the adjacent rear edge portions 21b of the adjacent protecting portions 21 becomes smaller than an opening length W4, in the upward and downward direction, between the adjacent tip portions 21a of the adjacent protecting portions 21.

A length (a depth) H of the protecting portion 21 in the forward and rearward direction of the motor vehicle, a height (a length between the rear edge portions) W of a rear surface 21d thereof, and an angle α of the tip portion 21a may be set appropriately, at least as long as the height W is set to be longer than a length of the tube 5 of the heat exchanger 1 in the upward and downward direction, namely an outer diameter of the tube 5.

[0020] In addition, as shown in FIG 9 and FIG 10, the connecting portions 22 and 23 are provided on rear surfaces thereof with a plurality of fixing portions 24 (three fixing portions on each connecting portion 22, 23 in this embodiment) which are shaped like a circular cylinder and project rearward from the rear surfaces. The fixing portions 24 are formed with pins 24a and 24b that are

formed like a circular cylinder and project from their end portions in the upward direction and the downward direction, respectively.

[0021] As shown in FIG. 2, a pair of pins 24a and 24b provided on each fixing portion 24 is engaged with the embossed portions 10 of the respective shells 7 and 8 of the heat exchanger 1, so that the protect member 20 is fixed at the front side of the core part 2 of the heat exchanger 1.

Accordingly, the embossed portions 10 can press and position the inner fin 9 at the inner side of the embossed portions 10, and at the same time the pins 24a and 24b of the fixing portions 24 of the protect member 20 can be engaged with the respectively corresponding outer sides of the embossed portions 10.

In this state, each protecting portions 21 of the protect member 20 covers the respectively corresponding tubes 5, and the respectively corresponding outer fins 6 are arranged between the adjacent rear edge portions 21b of the adjacent protecting portions 21.

[0022] Incidentally, in the first embodiment, although small clearances W5 are formed between the protect member 20 and the tubes 5 of the heat exchanger 1 as shown in FIG 12, they may be contacted with each other.

[0023] Next, the operation of the protect structure of the heat exchanger for the motor vehicle of the first embodiment will be described.

In the above-constructed intercooler, as shown in FIG 7, an intake air, which has been compressed by a not-shown supercharger to have a temperature of approximately 160°C, enters the inlet passage R1 through the inlet port 3. The intake air is indicated by dashed lines in FIG. 7. The intake air is cooled down to approximately 40°C due to heat exchange, between the intake air and the airflow generated when the motor vehicle is running and/or the airflow generated by the motor fan, through the outer fins 6 while it flows through the tubes 5 into the outlet passage R2. This intake air cooled is discharged through the outlet port 4 to an engine.

[0024] In this cooling operation, as shown in FIG 12, the airflow Z generated when the motor vehicle is running or the airflow Z generated by the motor fan is separated in the upward direction and in the downward direction at the tip portions 21a of the protecting portions 21 to smoothly flow to the respectively corresponding outer fins 6 along adjacent slanted portions 21e of the protecting portions 21.

[0025] Therefore, each protecting portions 21 of the protect member 20 can function to smoothly guide the airflow Z to the outer fins 6.

[0026] In addition, the projecting portions 21 can prevent the attack object X, such as a rock flying from the front side of the core part 2, from being collided with the tubes 5, thus avoiding damage and/or a crack in the tubes 5.

When the attack object X is flown from the oblique front side toward the core part 2 at a certain angle α_1 , the protecting portions 21 can surely protect the core part 2,

especially the tubes 5 of the core part 2.

On the other hand, when the attack object X is flow toward the core part 2 at an angle smaller than the certain angle α_1 , in other words at an angle close to a vertical direction, to pass through the clearance formed between the protecting portions 21, the attack object X that is larger than the opening length W3 cannot pass through the clearance, because the opening length W3, between the adjacent rear edge portions 21b of the adjacent protecting portions 21, is set to be smaller than the opening length W4 between the tip portions 21b thereof. This maintains the damage of the core part 2 to the minimum.

When the attack object X is smaller than the opening length W3, the attack object X is collided with the outer fins 6, thus not causing the damage in the tubes 5.

[0027] Next, the effects of the protect structure of the heat exchanger for the motor vehicle of the first embodiment will be described.

As explained above, in the protect structure of the heat exchanger for the motor vehicle of the first embodiment, the core part 2 is composed of the plurality of tubes 5 and outer fins which are alternately arranged with each other, and the protect member 20 is provided at the front side of the core part 2. The protect member 20 extends in the longitudinal direction of the tubes 5 in a state where the protect member 20 covers the front sides of the tubes 5 of the core part 2, being provided with the protecting portions 21 for avoiding the collision between the core part 2 and the attack object X that is flown from the oblique front side of the motor vehicle toward the core part 2. Therefore, in the first embodiment, the tubes 5 can be surely protected, by avoiding the collision between the core part 2 and the attack object X flown from the oblique front side of the motor vehicle toward the core part 2.

[0028] In addition, the cross sections of the projecting portions 21 are formed in such a way that the opening length W3, which is formed between the adjacent rear edge portions 21b of the adjacent protecting portions 21, is set to be smaller than the opening length W4 formed between the adjacent front tip portions 21a thereof. Therefore, this can provide an intake air guide function, preventing the attack object X that is larger than the opening length W3 from passing through the clearances formed between the protecting portions 21 to collide with the tubes 5.

[0029] Further, the projecting portions 21 are formed to have the cross section formed in the approximately triangular shape which is converged toward the front side of the motor vehicle. Therefore, the projecting portions 21 can have the shape suitable for effectively guiding the airflow Z.

[0030] Further, the inner fins 9 are installed inside the tubes 5 of the heat exchanger 1, and they are positioned by using the embossed portions 10 formed on the tubes 5. The protect member 20 is provided with the fixing portions 24, which are engaged with the embossed portions 10 so that the protect member 20 can be fixed to the heat exchanger of the motor vehicle. Therefore, the embossed

portions 10 can be used for positioning the inner fins 9 and also for fixing the protect member 20.

[0031] A second embodiment according to the present invention will be described.

In the second embodiment, its parts/portions similar to those of the first embodiment are indicated by the same reference numbers as those of the first embodiment, and their explanations will be omitted. Different parts/portions of the second embodiment will be described below in detail.

[0032] FIG 13 is a cross sectional view showing protecting portions of a protect structure, of a heat exchanger for a motor vehicle, of the second embodiment.

[0033] As shown in FIG 13, in the protect structure of the heat exchanger for the motor vehicle of the second embodiment, each protecting portions 30 is formed to have a cross section formed in an approximately semi-circular shape at a front side of the protecting portions 30, which is different from those of the first embodiment.

[0034] Therefore, the second embodiment can obtain the effects similar to those of the first embodiment, and it can save its weight by cutting down excessive material for forming the protecting portions 30. In addition, since there is no pointed portion at the front side of the protecting portions 30, the attack object might be not stuck on the protecting portions 30.

[0035] Although the embodiments have been described above, the present invention is not limited to the embodiments, and design changes and modifications are included in the present invention as long as they depart from the scope of the present invention.

For example, the heat exchanger for the motor vehicle is not limited to an intercooler, and it may be applied to all kinds of general heat exchangers for motor vehicles, such as a radiator, a condenser, an integral heat exchanger in which a radiator and a condenser are integrally assembled with each other, and an oil cooler.

In addition, the cross sectional shapes of the protecting portions are not limited to the approximately triangular shape or the approximately semi-circular shape, and they may be set appropriately.

Claims

1. A protect structure of a heat exchanger (1) for a motor vehicle, the protect structure comprising:

a core part (2) of the heat exchanger (1) including a plurality of tubes (5, 5a, 5b) and fins (6) that are alternately arranged with each other; and

a protect member (20) that is provided at a front side of the core part (2), wherein

the protect member (20) has a plurality of protecting portions (21; 30) extending in a longitudinal direction of the tubes (5, 5a, 5b) to cover front sides of the tubes (5, 5a, 5b) of the core

part (2) and avoid a collision between the core part (2) and an attack object (X) that is flown from an oblique front side of the motor vehicle toward the core part (2).

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2. The protect structure of the heat exchanger (1) for the motor vehicle according to claim 1, wherein the protecting portions (21; 30) are formed to have a cross section so that an opening length (W3) formed between adjacent rear edge portions (21b) of the adjacent protecting portions (21; 30) is set to be smaller than an opening length (W4) formed between adjacent front tip portions (21a) of the adjacent protecting portions (21; 30). 10
3. The protect structure of the heat exchanger (1) for the motor vehicle according to claim 1 or claim 2, wherein the protecting portions (21) are formed to have a cross section formed like a triangular shape which is converged toward a front side of the motor vehicle. 15 20
4. The protect structure of the heat exchanger (1) for the motor vehicle according to claim 1 or claim 2, wherein the protecting portions (30) are formed to have a cross section formed like a semi-circular shape at a front side of the motor vehicle. 25
5. The protect structure of the heat exchanger (1) for the motor vehicle according to any one of claims 1 to 4, wherein an inner fin (9) is installed inside each of the tubes (5) of the heat exchanger (1), being positioned by a plurality of embossed portions (10) formed on the tubes (5), and the protect member (20) is provided with a plurality of fixing portions (24) which are engaged with the embossed portions (10) so that the protect member (20) is fixed to the heat exchanger (1). 30 35 40

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FIG. 1

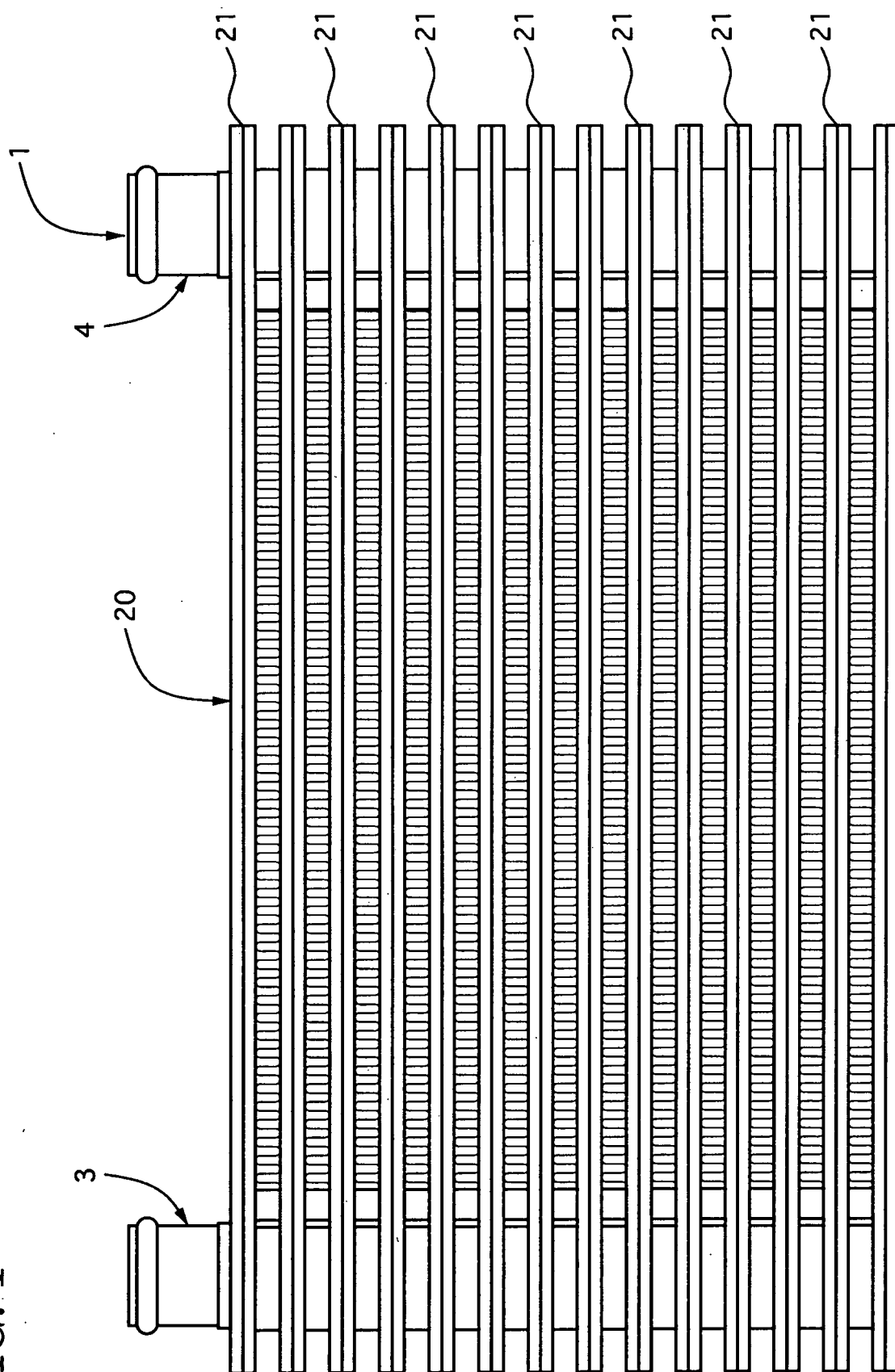


FIG. 2

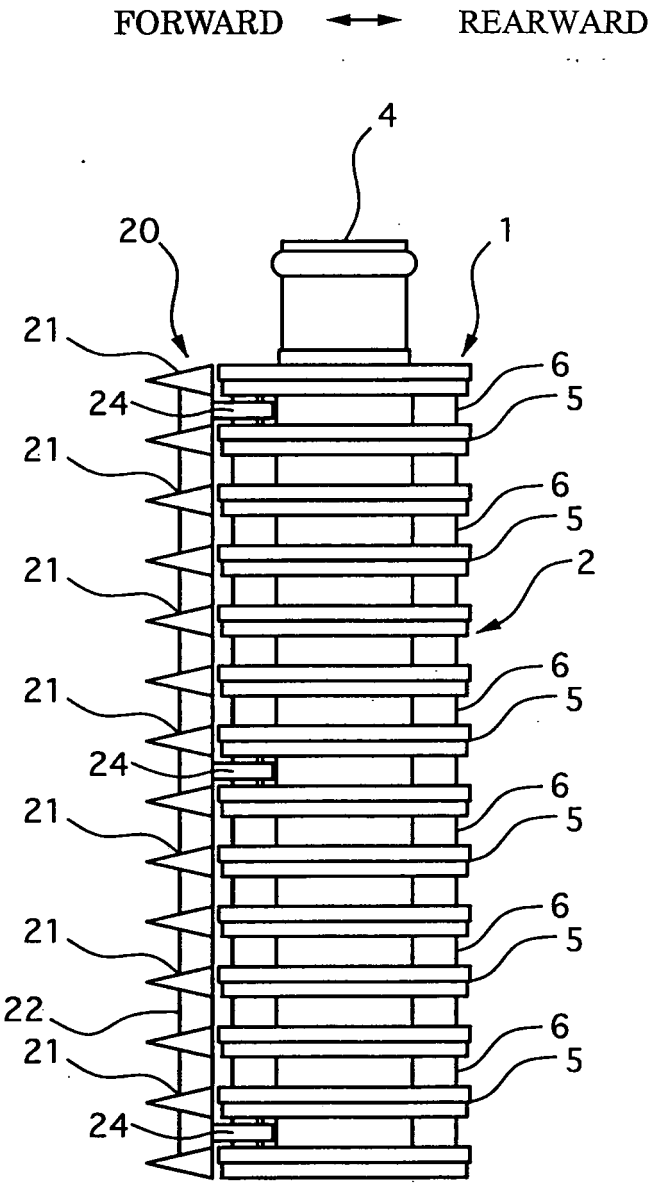


FIG. 3

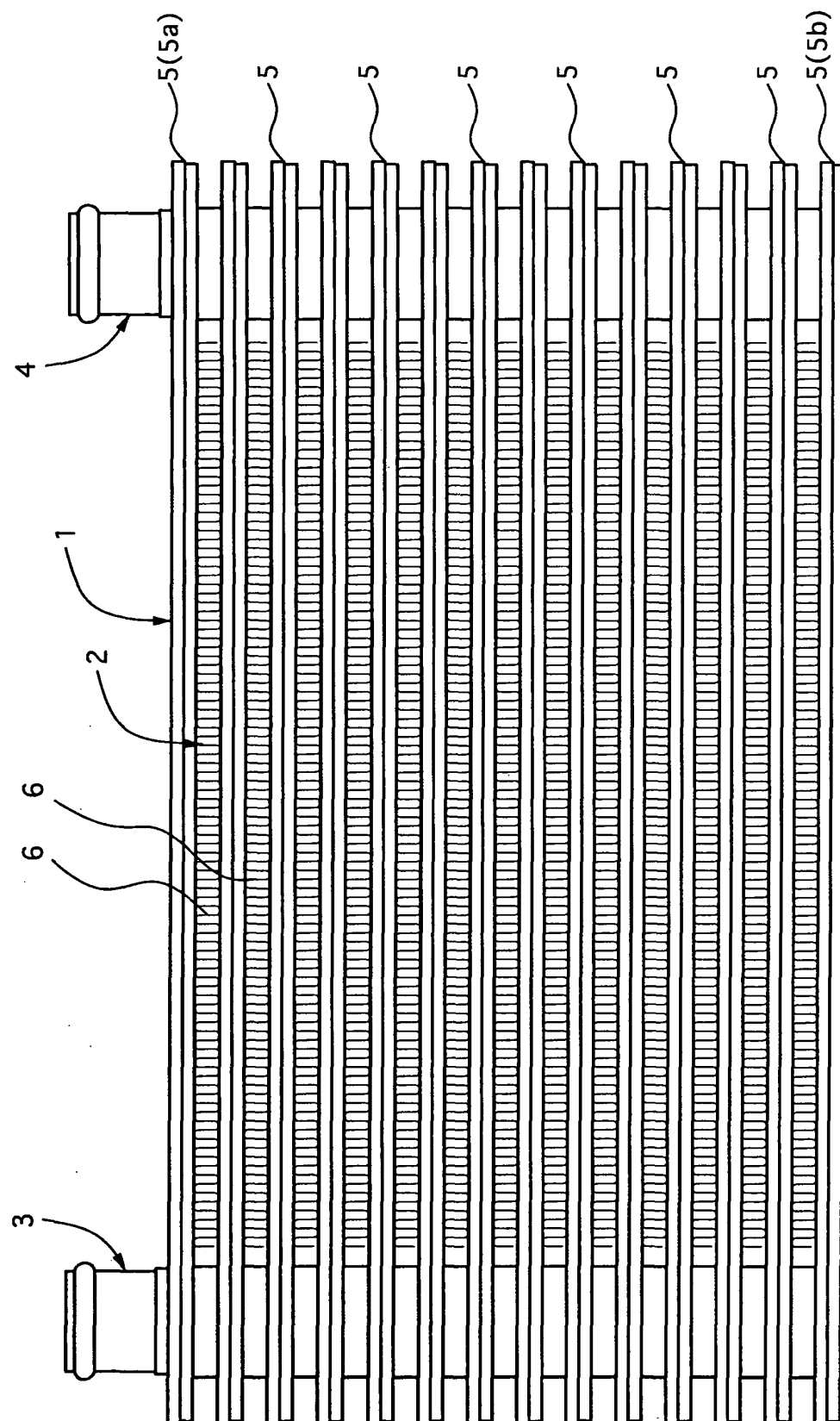


FIG. 4A

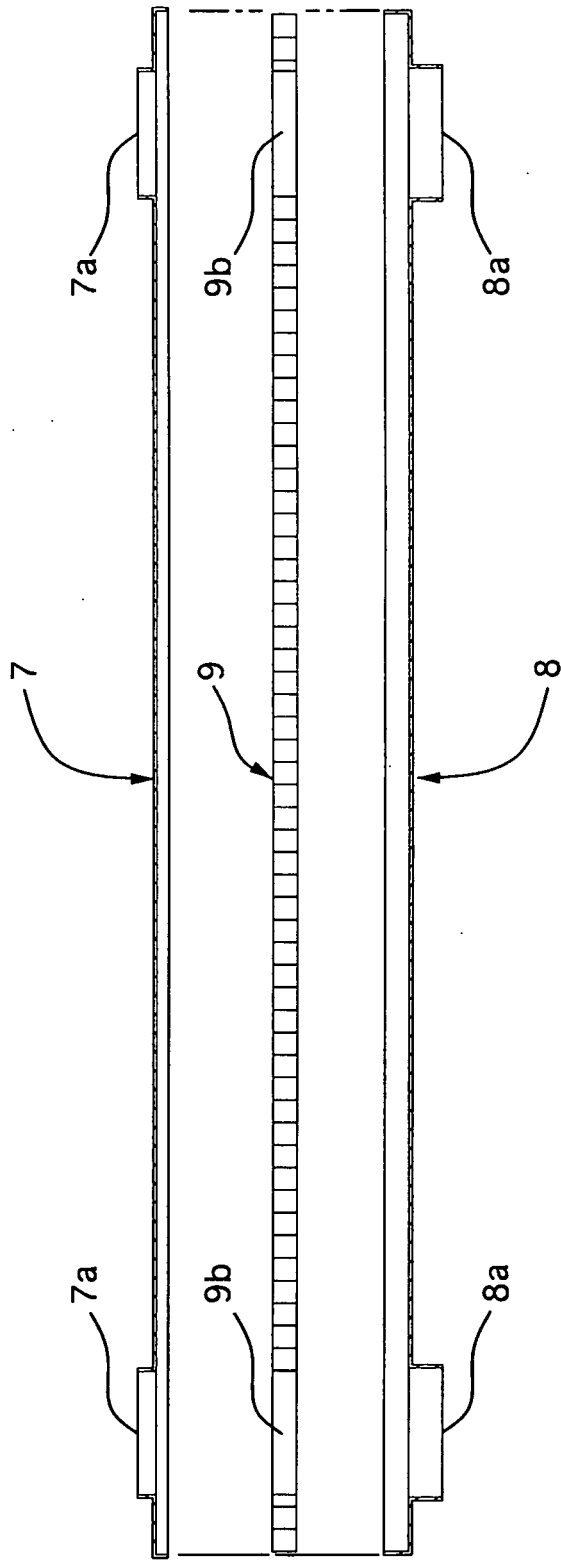


FIG. 4B

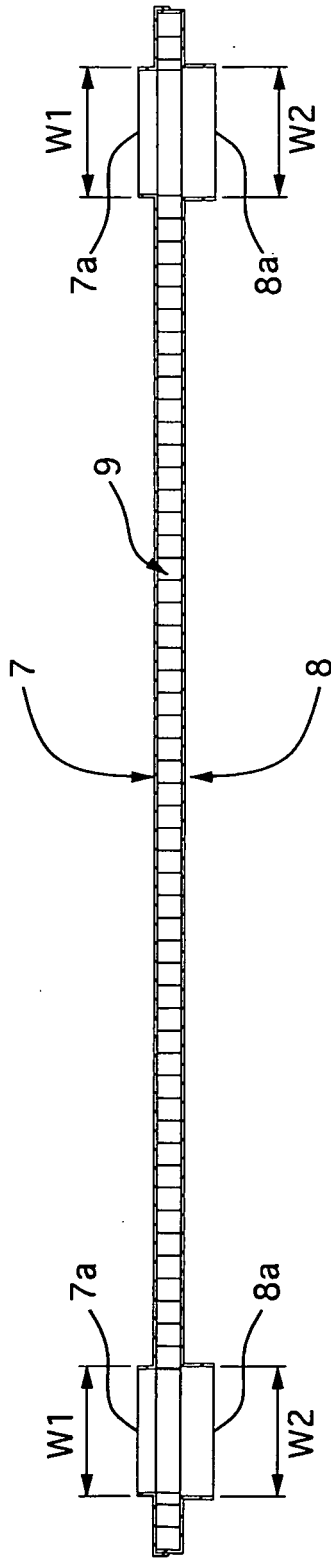


FIG. 5

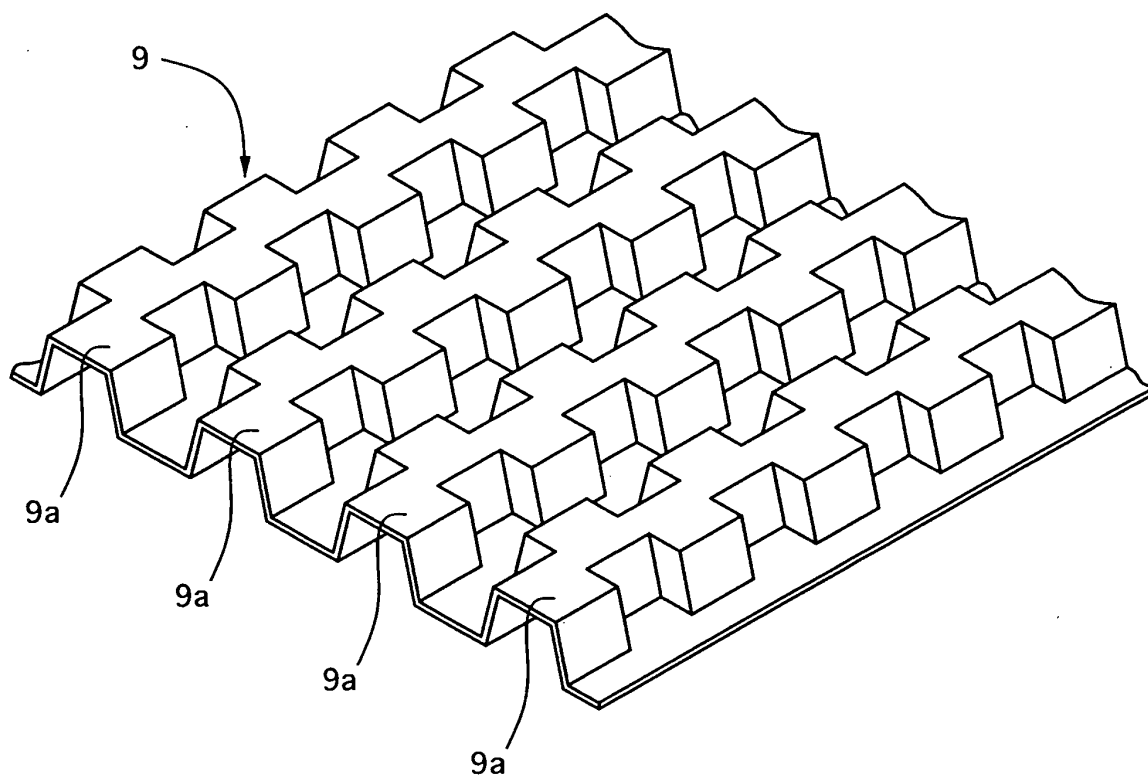


FIG. 6

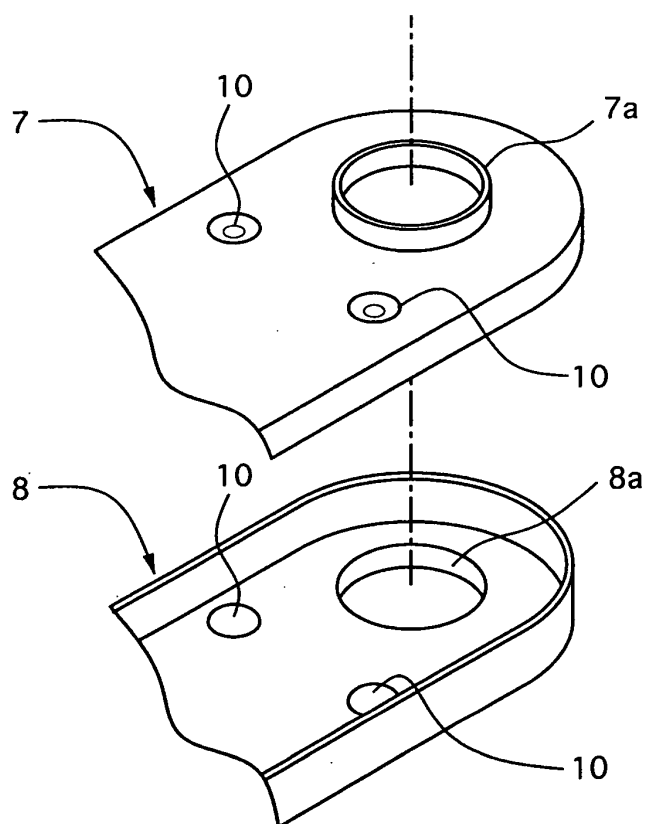


FIG. 7

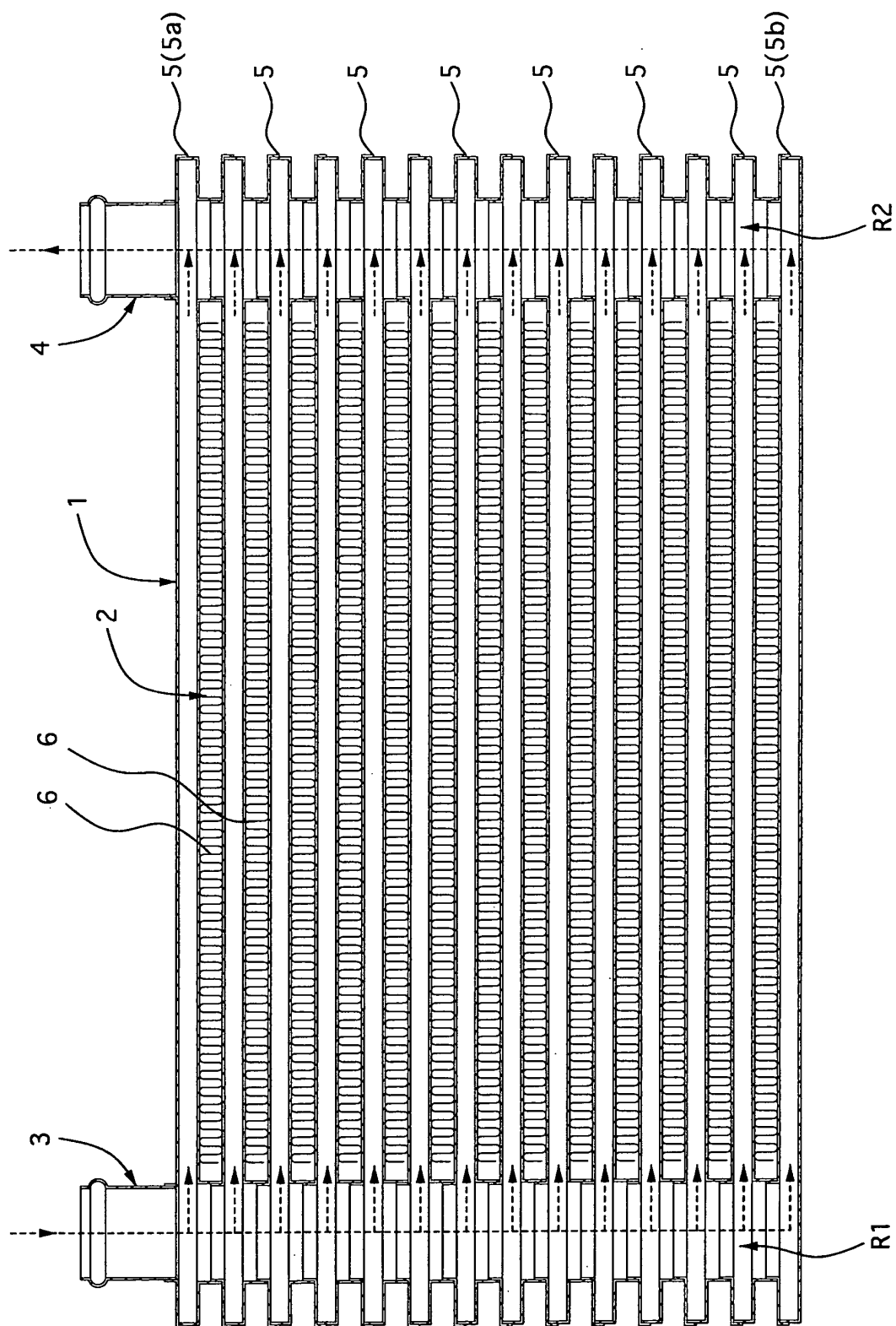


FIG. 8

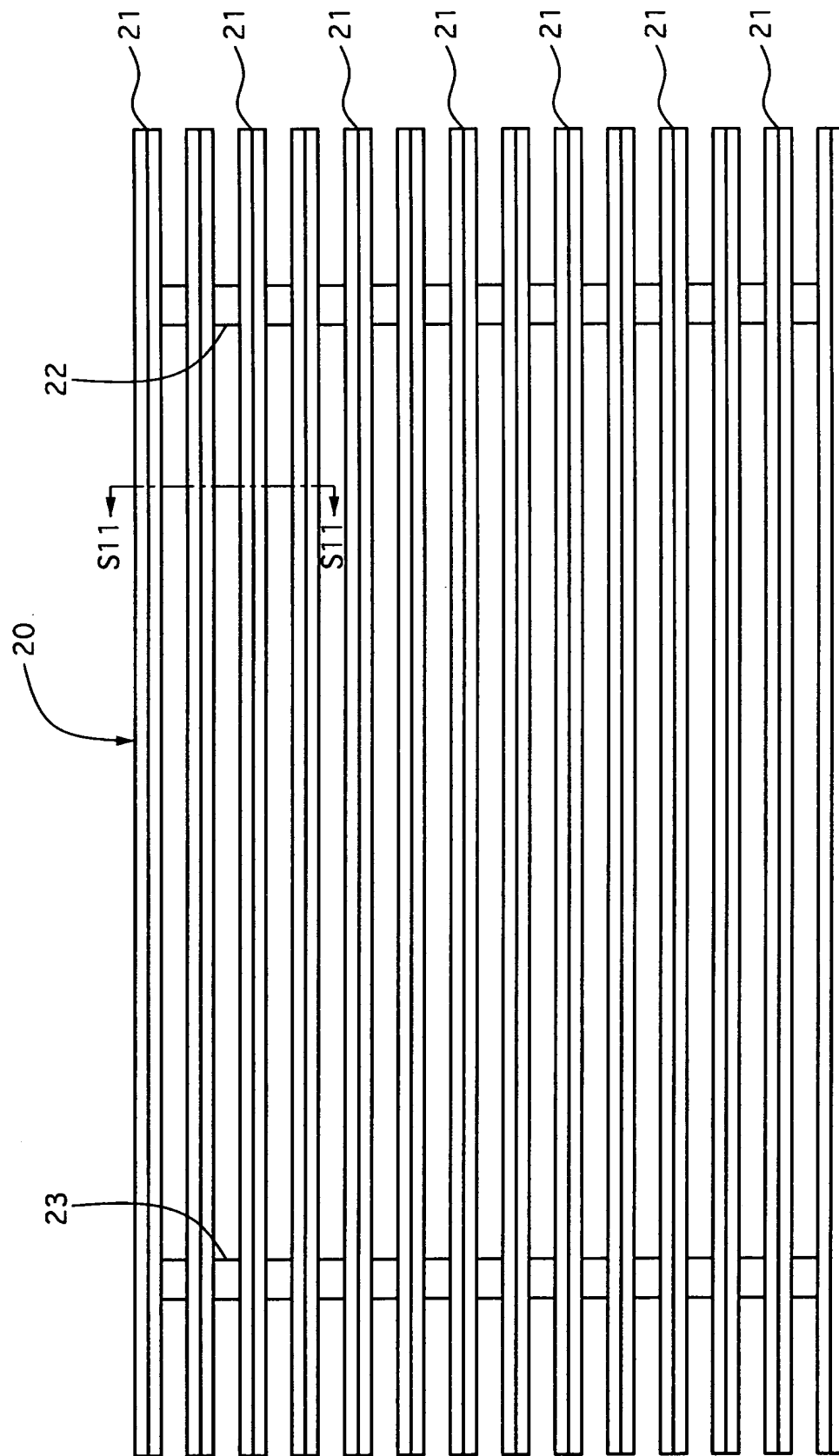


FIG. 9

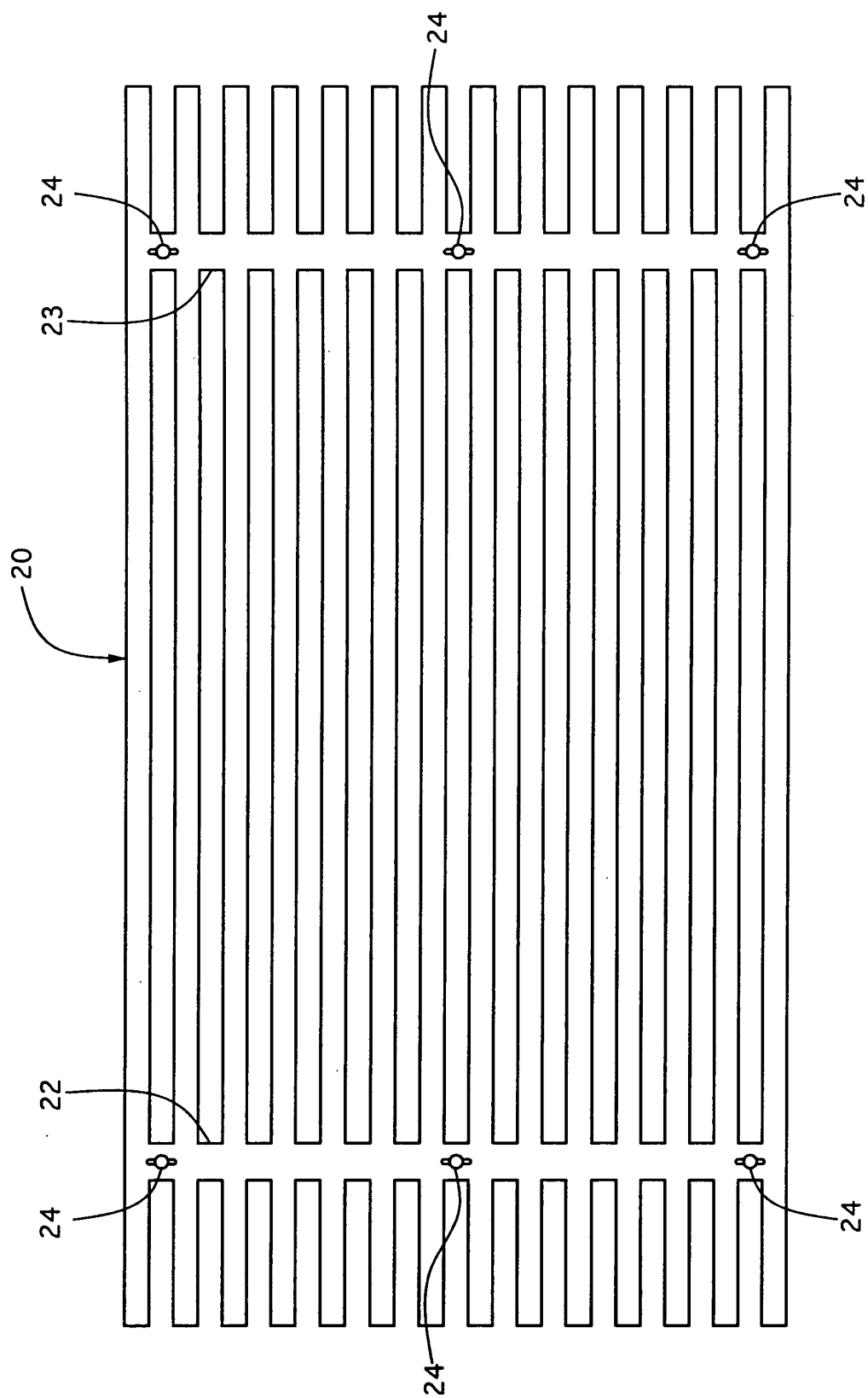


FIG. 10

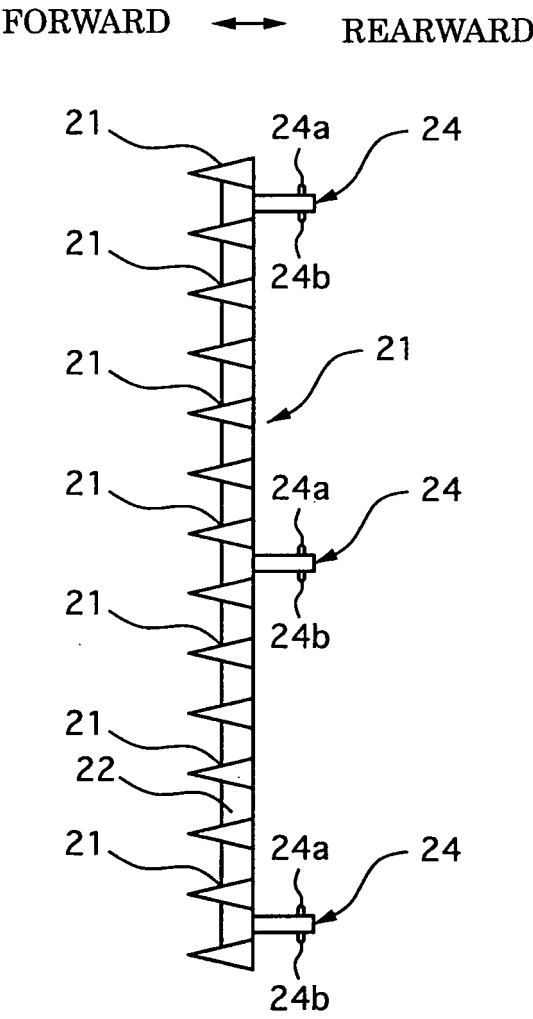


FIG. 11

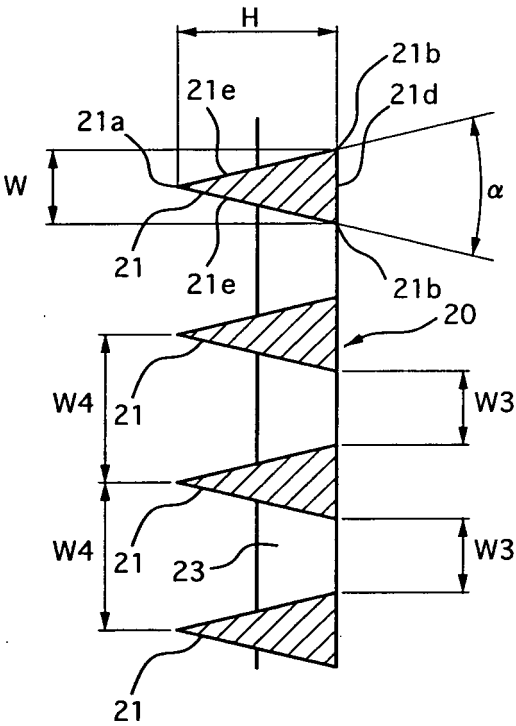


FIG. 12

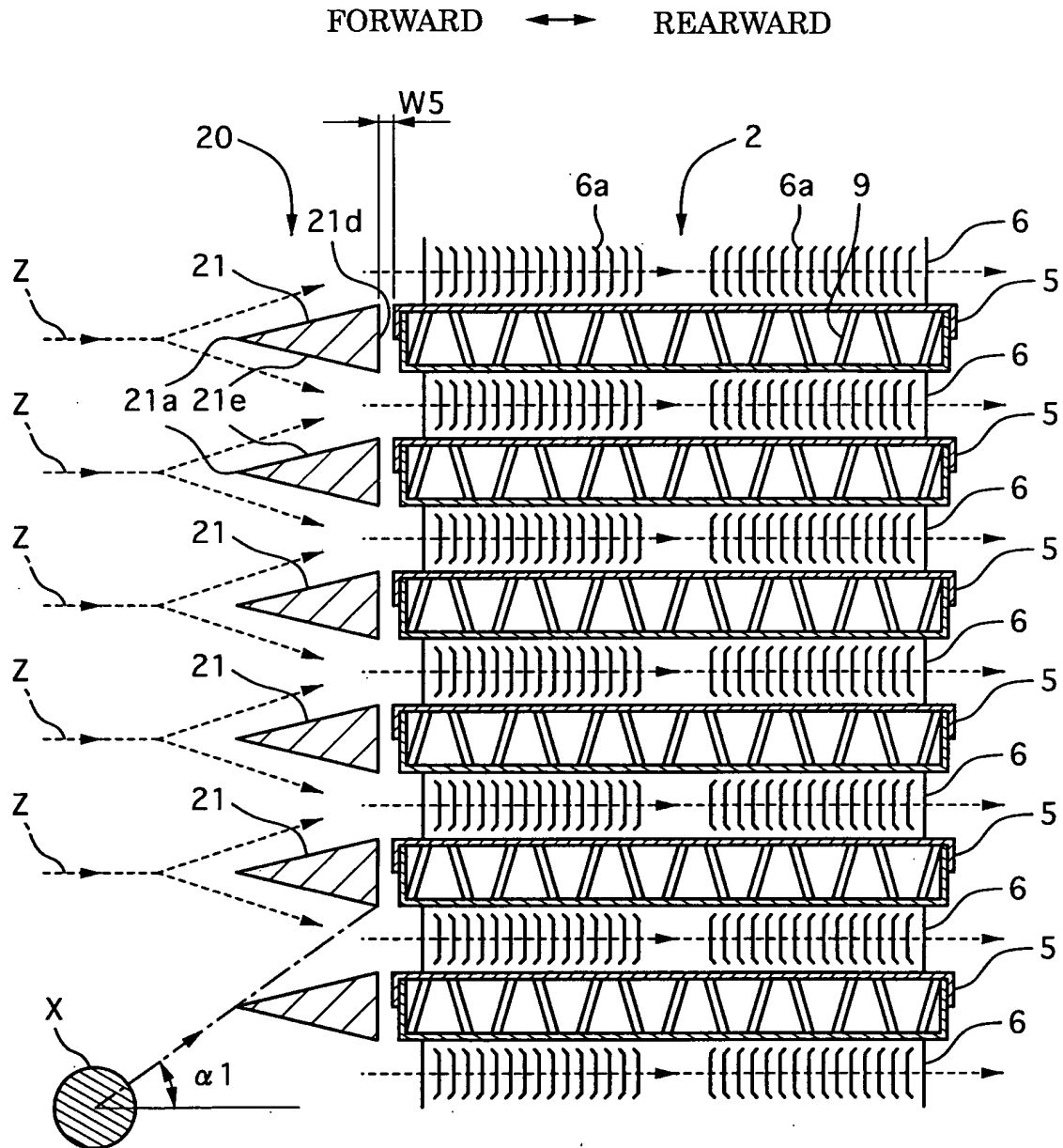
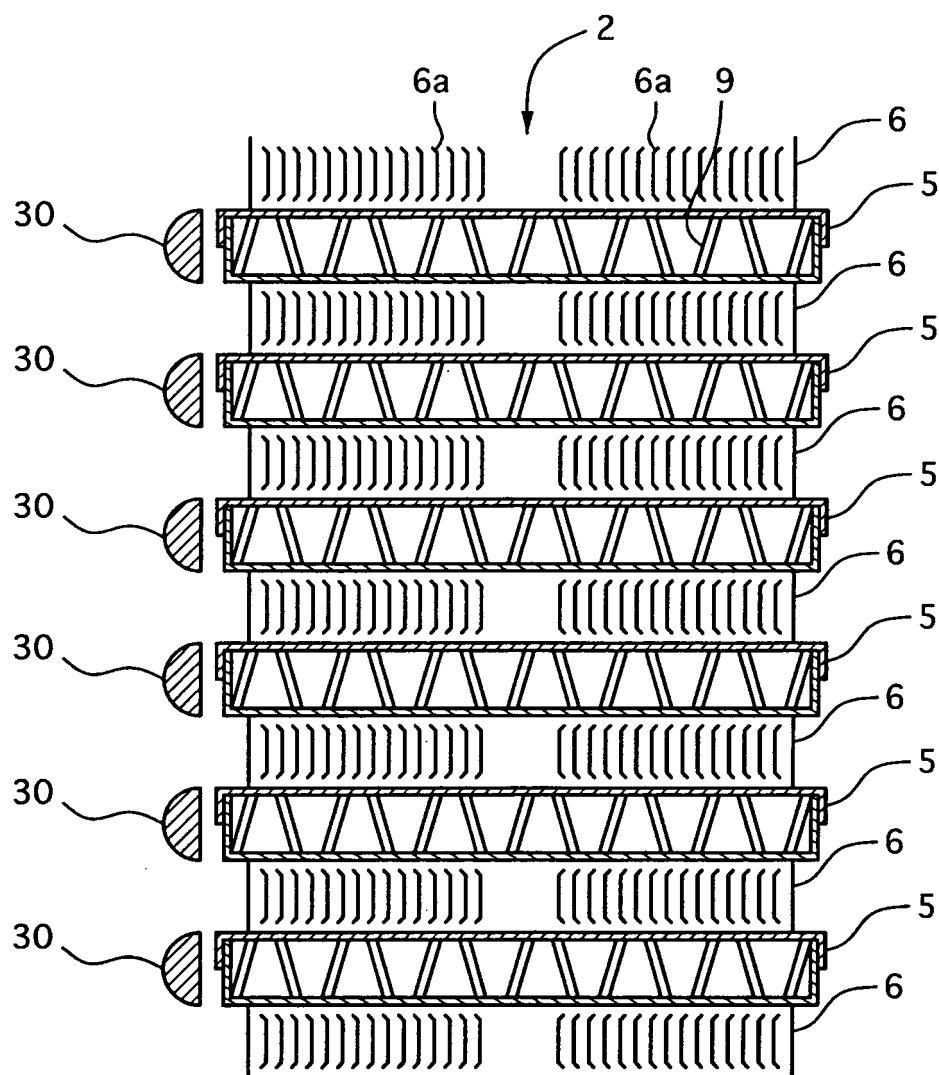


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/057376

A. CLASSIFICATION OF SUBJECT MATTER <i>F01P3/18(2006.01)i, B60K11/04(2006.01)i, F01P11/14(2006.01)i, F28F1/40(2006.01)i, F28F9/00(2006.01)i</i> According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) <i>F01P3/18, B60K11/04, F01P11/14, F28F1/40, F28F9/00</i> Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007 Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2003-279278 A (Denso Corp.), 02 October, 2003 (02.10.03), Full text & US 2003/0141046 A1	1, 4 2, 3 5
Y	JP 2-93299 A (Komatsu Ltd.), 04 April, 1990 (04.04.90), Full text (Family: none)	2, 3
A	JP 2004-60920 A (Denso Corp.), 26 February, 2004 (26.02.04), Full text (Family: none)	5
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 25 April, 2007 (25.04.07)		Date of mailing of the international search report 15 May, 2007 (15.05.07)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/057376

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Form PCT/ISA/210 (continuation of second sheet) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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