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(54) FLUE GAS HEAT EXCHANGER AND FIN THEREFOR

RAUCHGAS-WÄRMETAUSCHER MIT RIPPEN

ECHANGEUR THERMIQUE A GAZ DE FUMEE ET SES AILETTES

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- **PATENT ABSTRACTS OF JAPAN, Vol. 8, No. 160, M-312; & JP,A,59 056 089, (MATSUSHITA DENKI SANGYO K.K.), 31 March 1984.**

EP 0 897 521 B1

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Description

Background of the invention

[0001] The present invention relates to a flue gas exchanger comprising plane fins that extend from a first end to a second end of a jacket along and inside the jacket and that are assembled into blocks.

[0002] DE 888 255 describes a flue gas exchanger comprising a chamber with a ribbed tube that extends along the chamber. The ribbed tube comprises ribs extending perpendicularly in relation to a longitudinal axis of the chamber. The ribs are provided with inlets and outlets for the flue gas. The inlets and outlets are constituted by segments of a circle having a constantly decreasing or increasing height. A cooling medium extends through a central tubing of the ribbed tube.

[0003] The flue gas exchanger described in the above publication possesses some disadvantages. It involves large costs to produce a ribbed tube and at the same time the production has to be made for a specific dimensioning of the flue gas exchanger. Besides, a flue gas exchanger with a ribbed tube of the above-mentioned type with inlets and outlets constituted by segments of a circle has a limited capacity. The flue gas will be conducted to a centre of the jacket and cooling the ribs must take place by means of the central tubing having a limited surface area. Furthermore, the degree of rib effect is poor in a tube with external ribs. Finally, a ribbed tube having ribs that are provided with segments of a circle has a certain flow resistance towards the flue gas.

[0004] JP,A,59-56089 describes a heat exchanger with annular disk refrigerant flow path members which are inserted into an annular space so that they are connected in a heat conductive manner to the outer wall of the heat transfer tube and are contacted with the inner wall of an outer tube. Each annular disk flow path members are arranged by laminating a multitude of them in vertical direction so that they can form a multitude of annular paths while the annular disk fins, provided with flanges having diameters smaller than the outer diameters of the annular disks and equal to the inner diameters of the same, are provided in the annular path.

[0005] This heat exchanger has the disadvantage that the flow of flue gas through the heat exchanger is very restricted thereby reducing the capacity. Consequently, the area of inlets or outlets in the flow path members amounts to a very low multiple of the size of a cross section area of channels between adjacent flow path members. Furthermore the heat exchanger both has actual flow path members but also has annular disk fins without inlets or outlets. This further restricts the flow of flue gas through the heat exchanger and thereby the capacity of the heat exchanger and gives a different flow of flue gas compered to as example DE 888 255.

[0006] Thus, it is the object of the present invention to provide a flue gas exchanger that does not possess the disadvantages discussed above and which consequently increases the possibility of cooling the flue gas and reduces the flow resistance in order to increase the capacity.

[0007] This object is obtained by a flue gas exchanger where said fins being arranged at a mutual distance and forming channels between adjacent fins, each of said blocks comprising an initial fin with an opening forming an inlet and subsequent fins each being provided with a first opening forming an inlet, alternatively an outlet, and a second opening forming an outlet, alternatively an inlet, and of said blocks a last block also comprising a last fin with an opening forming an outlet, and said inlets, respectively outlets, being intended for admitting a flow of a flue gas from the first end of the jacket through the inlets and outlets of the fins to the second end of the jacket, and said inlets, respectively outlets, forming inlet chambers, respectively outlet chambers, which are interconnected by the channels, and a total open area of inlets and outlets in the fins which is identical for each fin amounting to a multiple of between 1.0 and 1.5, preferably 1.1, of the size of a cross section area of the channels between adjacent fins, and the open area of the inlets, alternativly the outlets, decreasing, and simultaneously the open area of the outlets, alternatively the inlets, increasing through each block in the intended direction of flow of the flue gas.

[0008] In a preferred embodiment the inlets and outlets in the fins are constituted by sectors of a circle extending from a central part to an outer periphery so that the flue gas is conducted towards the jacket.

[0009] By constructing a flue gas exchanger with these characteristics, one obtains a flue gas exchanger having a very low flow resistance. This means that the capacity is exclusively determined by the physical dimensions of the flue gas exchanger and the cooling taking place in the flue gas exchanger and is not limited by unfavourable flow conditions in the flue gas exchanger. Also, the flue gas being conducted towards the inner jacket increases the heat exchange substantially.

[0010] The fins are preferably produced as individual fins, which are positioned on a central guiding element. The number and dimensions of the fins may vary in order to provide the flue gas exchanger with different capacities and with different other physical and thermal characteristics. This means that the diameter and length of the flue gas exchanger may be altered by using fins of a different diameter or by using a different number of fins.

[0011] EP 0 571 881 describes a heat exchanger formed by fins, which are assembled into a block. The fins comprises openings that constitute sectors of a circle. The fins are assembled in such a manner that two helical channels are formed in the block. The heat exchanger described may be used for both fluent and gaseous media. US 3.731.733 describes a similar heat exchanger formed with fins, which are assembled in blocks each with two fins. These fins also are assembled in such a manner that two, alternatively three, helical chan-

nels are formed in the block.

[0012] The fins of these heat exchangers have the disadvantages that they are not to a sufficient extent able to create a forced flow, e.g. of a flue gas. The object of the heat exchanger described is to reduce the flow resistance. However, a helical channel established with this known technique will not to a sufficient extent ensure proper cooling of the flue gas since the latter will be conducted through a short channel with a large flow cross-section resulting in a high ratio between the cross section area of the channels between the fins and the area of the inlets and outlets of the fins. Furthermore the fins of EP 0 571 881 are not provided with an actual inlet and outlet but merely help to form the helical channels. Thus, two openings form two channel systems. Besides, the material consumption is very large compared to the heat transmission area, and the surface in the channels is angular, which increases the flow resistance.

[0013] Fins in which inlets and outlets consist of sectors of a circle have the advantage that the flue gas is conducted towards outer areas of the ribs. Thus, cooling of the ribs may take place at the jacket, which has a considerably larger surface area than any central tubing. The jacket and the ribs correspond to a tube with internal ribs as opposed to a tube with external ribs, in which cooling takes place at the internal tube having a small surface area. This increases the capacity of the flue gas exchanger and, also, the flue gas exchanger according to the invention with a given capacity has considerably smaller dimensions than known flue gas exchangers with the same capacity.

[0014] The sectors of a circle help to obtain the low flow resistance. The sectors of a circle vary in size in such a manner that in a block of fins there is a constant reduction of the open area of the inlets while at the same time there is a constant widening of the open area of the outlets through the block. The total area of inlet and outlet is identical for each fin.

[0015] A simple way of producing the sectors of a circle in each fin is using a punching tool having the shape of a sector of a circle and with an angle corresponding to the smallest sector to be made in a fin. Other sectors of a circle are produced as a multiple of the smallest sector by using the same punching tool and simply perform a number of adjacent punchings corresponding to the required multiple of the smallest sector. The fins of a preferred embodiment are produced from aluminium.

[0016] The flue gas exchanger according to the invention may be used in many contexts, e.g. as a heat exchanger from a fuel device in a central heating installation. It is also possible to use the flue gas exchanger according to the invention for different kinds of vessels.

Description of the drawing

[0017] The invention will now be described in further detail with reference to the accompanying drawing, wherein

- Fig. 1 is a section view through an embodiment of a heat gas exchanger according to the invention,
- Fig. 2 is plan views of fins according to the invention,
- Fig. 3 is a side view of a fin according to the invention, and
- Fig. 4 is a plan view of a block with several fins according to the invention.

[0018] Fig. 1 shows a section view through an embodiment of a flue gas exchanger according to the invention. The flue gas exchanger comprises a front cover 1 and a rear cover 2. An inner jacket 3 and an outer jacket 4 extend between the covers 1, 2. A chamber 5 between the inner jacket 3 and the outer jacket 4 is sealed by packings 6, 7 contacting the covers 1, 2. An inlet 8 for flue gas extends through the inner jacket 3 and the outer jacket 4. The inlet 8 may alternatively be provided in the front cover 1. A corresponding outlet 9 for the flue gas extends through the rear cover 2.

[0019] Fins 10 are assembled into blocks 11, which extend through the inner jacket 3. In the embodiment shown the flue gas exchanger comprises eight blocks 11 with eight adjacent fins 10 in each. Openings 20-34 (see Fig. 2A-2H) form an inlet chamber 35 and an outlet chamber 36 for each block 11. The inlet chamber and the outlet chamber are indicated by hatching. The fins 10 are mounted on a guiding element 13 extending through openings in a central part of the fins 10 (see Fig. 2). The guiding element 13 preferably has a rectangular cross section, and the openings in the fins 10 a corresponding rectangular cross-section (see Fig. 2). Hereby the fins 10 are prevented from rotating around the guiding element 13. The guiding element 13 is fastened to the rear cover 2 by means appropriate for the purpose (not shown).

[0020] A flow gas, illustrated by means of flow lines 14, extends through the flue gas exchanger from the inlet 8 to the outlet 9. The flue gas passes the fins 10, all of which, except from a frontmost fin and a rearmost fin, are provided with both an inlet and an outlet (see Fig. 2A-2H). Inlet and outlet are formed in the fins in such a manner that the flue gas is conducted towards the inner jacket 3. The frontmost fin is only provided with an inlet and the rearmost fin is only provided with an outlet.

[0021] The chamber 5 between the inner jacket 3 and the outer jacket 4 is designed to contain a cooling agent for cooling the flue gas that extends through the flue gas exchanger. An inlet (not shown) and an outlet (not shown) conduct the cooling medium into the chamber. The cooling medium is preferably a liquid such as water. The flue gas is cooled, and the cooling medium is heated and may subsequently be used as a heating medium, e.g. in a heat exchanger in a central heating installation.

[0022] Figs. 2A-2H show the fins 10 seen in a plan view. Shown in the figure are eight different fins 10 corresponding to the eight fins of which each block 11 (see Fig. 1) consists. The fins 10 comprise a plane part 15

and are all, except from a first fin, provided with openings, which constitute inlets and outlets. The inlets and outlets are substantially constituted by a sector of a circle extending from a central part 16 of each fin 10 to the vicinity of an outer periphery of the fin. The central part 16 of each fin is provided with an opening 18 having a rectangular cross-section. The guiding element 13 (see Fig. 1) is designed to extend through the openings 18 in each fin 10. Along the outer periphery 17 each fin is provided with a flange 19 (see Fig. 3).

[0023] A firsts fin shown in Fig. 2A is provided with a first opening 20 constituting an inlet, alternatively an outlet. Whether the opening 20 constitutes an inlet or an outlet (see Fig. 1), depends on the block 11 in which the fin 10 is positioned. If the fin 10 is positioned in a first block, a third block, a fifth block, etc., seen from the left in Fig. 1, the opening constitutes an inlet. If the fin 10 is positioned in a second block, a fourth block, a sixth block, etc., seen from the left in Fig. 1, the opening constitutes an outlet.

[0024] The openings in the fins 10 are produced by punching with a punching tool having the shape of the smallest opening. The larger openings all form a multiple of the smallest opening. Thus, one and the same tool may be used for all openings by performing several adjacent punchings corresponding to the multiple of the smallest punching constituted by the opening in question. It is only necessary to produce five different fins in order to provide eight fins such as shown in the figure since the fins in Fig. 2B, 2C, respectively 2D, are identical with the fins in Fig. 2F, 2G, respectively 2H, only rotated 180° in relation to one another.

[0025] As mentioned, the first fin is provided with a first opening 20. The opening is constituted by a sector of a circle having an angle of 100°. A second fin is provided with a first opening 21 constituted by a sector of a circle having an angle of 87.5° and a second opening 22 constituted by a sector of a circle of 12.5°. A third fin is provided with a first opening 23 constituted by a sector of a circle having an angle of 75° and a second opening 24 constituted by a sector of a circle of 25°. A fourth fin is provided with a first opening 25 constituted by a sector of a circle having an angle of 62.5° and a second opening 26 constituted by a sector of a circle of 37.5°. A fifth fin is provided with a first opening 27 constituted by a sector of a circle having an angle of 50° and a second opening 28 constituted by a sector of a circle of 50°. A sixth fin is provided with a first opening 29 constituted by a sector of a circle having an angle of 37.5° and a second opening 30 constituted by a sector of a circle of 62.5°. A sixth fin is provided with a first opening 31 constituted by a sector of a circle having an angle of 25° and a second opening 32 constituted by a sector of a circle of 75°. A sixth fin is provided with a first opening 33 constituted by a sector of a circle having an angle of 12.5° and a second opening 34 constituted by a sector of a circle of 87.5°. The total open area of the openings forming inlet and outlet is identical for each fin.

[0026] Fig. 3 shows a fin 10 seen in a side view. As mentioned, the fin has a plane part 15 with the central part 16 in which the opening 18 is provided. Along the outer periphery 17 the fin is provided with the flange 19. The opening 18 in the central part 16 is also provided by a flange. The flange 19 along the outer periphery 17 gives the fin rigidity while at the same time creating a distance a between adjacent fins in a block 11 (see Fig. 1). The flange 19 is intended to contact the inner jacket 3 in a situation of use.

[0027] Fig. 4 shows a block 11 consisting of eight fins 10 as illustrated in fig. 2. The fins 10 are put together in the block 11 in such a manner that the plane part 15 of the first fin contacts the flange 19 of an adjacent second fin. The inlets, alternatively the outlets, are illustrated. It appears that the open area of the inlets, alternatively the outlets, decreases as the flue gas passes through the block 11. Simultaneously, the open area of the outlets, alternatively the inlets, increases. These are not illustrated. The channels 12 have a cross section area A seen parallel with the plane of the figure seen in an upward or downward direction. The cross section area A is determined as the distance a between the fins (see Fig. 3) multiplied by an extension b of the fins. The extension b of the embodiment shown is equal to the diametrical distance of the planes subtracted by an extension c of the guiding element. The total open area of each fin is equal to the cross section area A of each chamber 12 (see Fig. 1) multiplied by a factor of between 1.0 and 1.5, preferably 1.1.

[0028] The invention has been described above with reference to a specific embodiment of a flue gas exchanger according to the invention and for specific embodiments of fins. It will be possible to use alternative embodiments of both flue gas exchanger and fins. Thus, the flue gas exchanger may contain a number of blocks of fins other than eight, and the number of fins in each block may be different from eight. The fins may further have a shape other than circular, and the mutual distance between fins may be provided in a manner other than by a flange.

Claims

1. A flue gas exchanger comprising plane fins (10) that extend from a first end to a second end of a jacket (3) along and inside the jacket (3) and that are assembled into blocks (11), said fins (10) being arranged at a mutual distance and forming channels (12) between adjacent fins (10), each of said blocks (11) comprising an initial fin (10) with an opening (20) forming an inlet and subsequent fins (10) each being provided with a first opening (21-34) forming an inlet, alternatively an outlet, and a second opening (21-34) forming an outlet, alternatively an inlet, and of said blocks (11) a last block (11) also comprising a last fin (10) with an opening (20) forming

an outlet, and said inlets, respectively outlets, being intended for admitting a flow of a flue gas from the first end of the jacket (3) through the inlets and outlets of the fins (10) to the second end of the jacket (3), and said inlets, respectively outlets, forming inlet chambers (35), respectively outlet chambers (36), which are interconnected by the channels (12), and a total open area of inlets and outlets in the fins (10) which is identical for each fin amounting to a multiple of between 1.0 and 1.5, preferably 1.1, of the size of a cross section area (A) of the channels (12) between adjacent fins (10), and the open area of the inlets, alternativly the outlets, decreasing, and simultaneously the open area of the outlets, alternatively the inlets, increasing through each block (11) in the intended direction of flow of the flue gas.

2. A flue gas exchanger according to claim 1, **characterised** in that the inlets and outlets in the fins (10) are constituted by sectors of a circle extending from a central part (16) to an outer periphery (17)so that the flue gas is conducted toward the jacket (3).

3. A flue gas exchanger according to claim 1 or claim 2, **characterised** in that at least one block (11), preferably five blocks (11), extends along the jacket (3).

4. A flue gas exchanger according to claim 3, **characterised** in that each block (11) comprises eight fins (10), that a smallest sector of a circle is between 1° and 22.5°, preferably 12.5°, that a first fin comprises a first sector of a circle of eight times the smallest sector of a circle, that a second fin comprises a first sector of a circle of seven times the smallest sector of a circle and a second sector of a circle of one time the smallest sector of a circle, that a third fin comprises a first sector of a circle of six times the smallest sector of a circle and a second sector of a circle of two times the smallest sector of a circle, that a fourth fin comprises a first sector of a circle of five times the smallest sector of a circle and a second sector of a circle of three times the smallest sector of a circle, that a fifth fin comprises a first sector of a circle of four times the smallest sector of a circle and a second sector of a circle of four times the smallest sector of a circle.

5. A flue gas exchanger according to claim 3 or 4, **characterised** in that the fins are mounted on a guiding element (13), that the guiding element extends through openings (17) in a central part (16) of the fins (10), that the openings (17) and the guiding elements (13) have a mutual cross section, and that the cross section is non-circular.

6. A flue gas exchanger according to claim 1, 2 or 3, **characterised** in that the jacket comprises an inner jacket (3) and an outer jacket (4), between which a chamber (5) is formed, that the fins (10) extend along and inside the inner jacket (3), and that the outer jacket (4) is provided with an inlet and an outlet for a cooling medium, said cooling medium being intended to extend though the chamber (5).

Patentansprüche

1. Rauchgasaustauscher, der Folienkarten (10) umfasst, die sich von einem ersten Ende bis zu einem zweiten Ende eines Mantels (3) den Mantel (3) entlang und in dem Mantel (3) erstrecken, und die in Blöcke (11) gesammelt sind, welche Karten (10) mit gegenseitigem Abstand angebracht sind und Kanäle (12) zwischen beiliegenden Karten (10) bilden, jeder von den genannten Blöcken (11) eine erste Karte (10) mit einem Durchbruch (20) umfasst, der einen Einlauf bildet, und weitere Karten (10), wo jede mit einem ersten Durchbruch (21-34), der einen Einlauf, alternativ einen Auslauf bildet, und einem zweiten Durchbruch (21-34), der einen Auslauf, alternativ einen Einlauf bildet, versehen ist, und von den genannten Blöcken (11) ein letzter Block (11), der auch eine letzte Karte (10) mit einem Druchbruch (20) umfasst, der einen Einlauf bildet, und die genannten Einläufe, beziehungsweise Ausläufe, dazu bestimmt sind, einen Durchfluß eines Rauchgases von dem ersten Ende des Mantels (3) durch die Einläufe und Ausläufe der Karten (10) bis zu dem zweiten Ende des Mantels (3) zu gestatten, und die genannten Einläufe, beziehungsweise Ausläufe, Einlaufskammer (35), beziehungsweise Auslaufskammer (36) bilden, die miteinander durch Kanäle (12) verbunden sind, und ein ganz offener Bereich von Einläufen und Ausläufen in den Karten (10), der für jede Karte identisch ist, und das Vielfache von zwischen 1,0 und 1,5, vorzugsweise 1,1, der Größe des Querschnittbereiches (A) der Kanäle (12) zwischen beiliegenden Karten (10) beträgt, und der offene Bereich der Einläufe, alternativ der Ausläufe, sich verringert, und gleichzeitig der offene Bereich der Ausläufe, alternativ der Einläufe, durch jeden Block (11) in der bestimmten Richtung des Rauchgasdurchflußes sich vergrößert.

2. Rauchgasaustauscher nach Anspruch 1, dadurch **gekennzeichnet,** daß die Einläufe und Ausläufe in den Karten (10) aus Kreissektoren bestehen, die sich von einem zentralen Teil (16) zu einem äußeren Umkreis (17) in der Art erstrecken, daß das Rauchgas auf den Mantel zu geführt wird.

3. Rauchgasaustauscher nach Anspruch 1 oder Anspruch 2, dadurch **gekennzeichnet,** daß mindestens ein Block (11), vorzugsweise fünf Blöcke (11),

sich den Mantel (3) entlang erstreckt.

4. Rauchgasaustauscher nach Anspruch 3, dadurch **gekennzeichnet,** daß jeder Block (11) acht Karten (10) umfasst, daß ein kleinster Kreissektor zwischen 1° und 22,5°, vorzugsweise 12,5° ist, daß eine erste Karte einen ersten Kreissektor von acht mal dem kleinsten Kreissektor umfasst, daß eine zweite Karte einen ersten Kreissektor von sieben mal dem kleinsten Kreissektor und einen zweiten Kreissektor von ein mal dem kleinsten Kreissektor umfasst, daß eine dritte Karte einen ersten Kreissektor von sechs mal dem kleinsten Kreissektor und einen zweiten Kreissektor von zwei mal dem kleinsten Kreissektor umfasst, daß eine vierte Karte einen ersten Kreissektor von fünf mal dem kleinsten Kreissektor und einen zweiten Kreissektor von drei mal dem kleinsten Kreissektor umfasst, daß eine fünfte Karte einen ersten Kreissektor von vier mal dem kleinsten Kreissektor und einen zweiten Kreissektor von vier mal dem kleinsten Kreissektor umfasst.

5. Rauchgasaustauscher nach Anspruch 3 oder Anspruch 4, dadurch **gekennzeichnet**, daß die Karten auf ein Steuerelement (13) montiert sind, daß das Steuerelement sich durch Durchbrüche (17) in einem zentralen Teil (16) der Karten (10) erstreckt, daß die Durchbrüche (17) und die Steuerelemente (13) einen gegenseitigen Querschnitt aufweisen, und daß der Querschnitt nicht kreisförmig ist.

6. Rauchgasaustauscher nach Anspruch 1, 2 oder 3,, dadurch **gekennzeichnet,** daß der Mantel einen Innenmantel (3) und einen Außenmantel (4) umfasst, zwischen welche eine Kammer (5) gebildet ist, daß die Karten (10) sich den Innenmantel entlang und in dem Innenmantel (3) erstrecken, und daß der Außenmantel mit einem Einlauf und einem Auslauf für ein Kühlmedium versehen ist, welches Kühlmedium dazu bestimmt ist, sich durch die Kammer (5) zu erstrecken.

Revendications

1. Echangeur à gaz de fumée comprenant des disques (10) s'étendant d'une première extrémité à une deuxième extrémité d'un manteau (3) au long du et à l'intérieure du manteau (3) et qui sont unis en blocs (11), lesdits disques (10) étant montés à une distance mutuelle et formant des canaux (12) entre des disques adjacents (10), chacun desdits blocs (11) comprenant un premier disque (10) avec un orifice (20) formant une entrée et des disques consécutifs (10) chacun étant prévu d'un premier orifice (21-34) formant une entrée, alternativement une sortie, et un deuxième orifice (21-34) formant une sortie, alternativement une entrée, et desdits blocs (11) un dernier bloc (11) comprenant aussi un dernier disque (11) avec un orifice (20) formant une sortie, et lesdites entrées, respectivement sorties, étant destinées à permettre un écoulement d'un gaz de fumée de la première extrémité du manteau (3) à travers les entrées et les sorties des disques (10) à la deuxième extrémité du manteau (3), et lesdites entrées, respectivement sorties, formant des chambres d'entrée (35), respectivement des chambres de sortie (36), qui sont liées l'une à l'autre par des canaux (12), et une zone complètement ouverte d'entrées et de sorties dans les disques (10), qui est identique pour chaque disque s'élévant à un multiple d'entre 1,0 et 1,5, de préférence 1,1, de la taille d'une aire de section (A) des canaux (12) entre des disque adjacents (10), et la zone ouverte des entrées, alternativement des sorties, diminuant, et en même temps la zone ouverte des sorties, alternativement des entrées, augmentant à travers chaque bloc (11) dans la direction déterminée d'écoulement de gaz de fumée.

2. Echangeur à gaz de fumée selon la revendication 1, **caractérisé** en ce que les entrées et les sorties dans les disques (10) sont constituées par des secteurs circulaires s'étendant d'une partie centrale (16) à une périphérie extérieure (17) de sorte que le gaz de fumée est conduit vers le manteau (3).

3. Echangeur à gaz de fumée selon la revendication 1 ou la revendication 2, **caractérisé** en ce qu'au moins un bloc (11), de préférence cinq blocs (11), s'étendent au long du manteau (3).

4. Echangeur à gaz de fumée selon la revendication 3, **caractérisé** en ce que chaque bloc (11) comprend huit disques (10), qu'un plus petit secteur circulaire est entre 1° et 22,5°, de préférence 12,5°, qu'un premier disque comprend un premier secteur circulaire de huit fois le plus petit secteur circulaire, qu'un deuxième disque comprend un premier secteur circulaire de sept fois le plus petit secteur circulaire et un deuxième secteur circulaire d'une fois le plus petit secteur circulaire, qu'un troisième disque comprend un premier secteur circulaire de six fois le plus petit secteur circulaire et un deuxième secteur circulaire de deux fois le plus petit secteur circulaire, qu'un quatrième disque comprend un premier secteur circulaire de cinq fois le plus petit secteur circulaire et un deuxième secteur circulaire de trois fois le plus petit secteur circulaire, qu'un cinquième disque comprend un premier secteur circulaire de quatre fois le plus petit secteur circulaire et un deuxième secteur circulaire de quatre fois le plus petit secteur circulaire.

5. Echangeur à gaz de fumée selon la revendication

3 ou 4, **caractérisé** en ce que les disques sont montés sur un élément de guidage (13), que l'élément de guidage s'étend à travers les orifices (17) dans une partie centrale (16) des disques (10), que les orifices (17) et les éléments de guidage (13) ont une section mutuelle, et que la section est non-circulaire.

6. Echangeur à gaz de fumée selon la revendication 1, 2 ou 3, **caractérisé** en ce que le manteau comprend un manteau intérieur (3) et un manteau extérieur (4), entre lesquels une chambre (5) est établie, que les disques (10) s'étendent au long du et à l'intérieure du manteau intérieur (3), et que le manteau extérieur (4) est prévu d'une entrée et d'une sortie pour un agent frigorigène, ledit agent frigorigène étant destiné à s'étendre à travers la chambre (5).

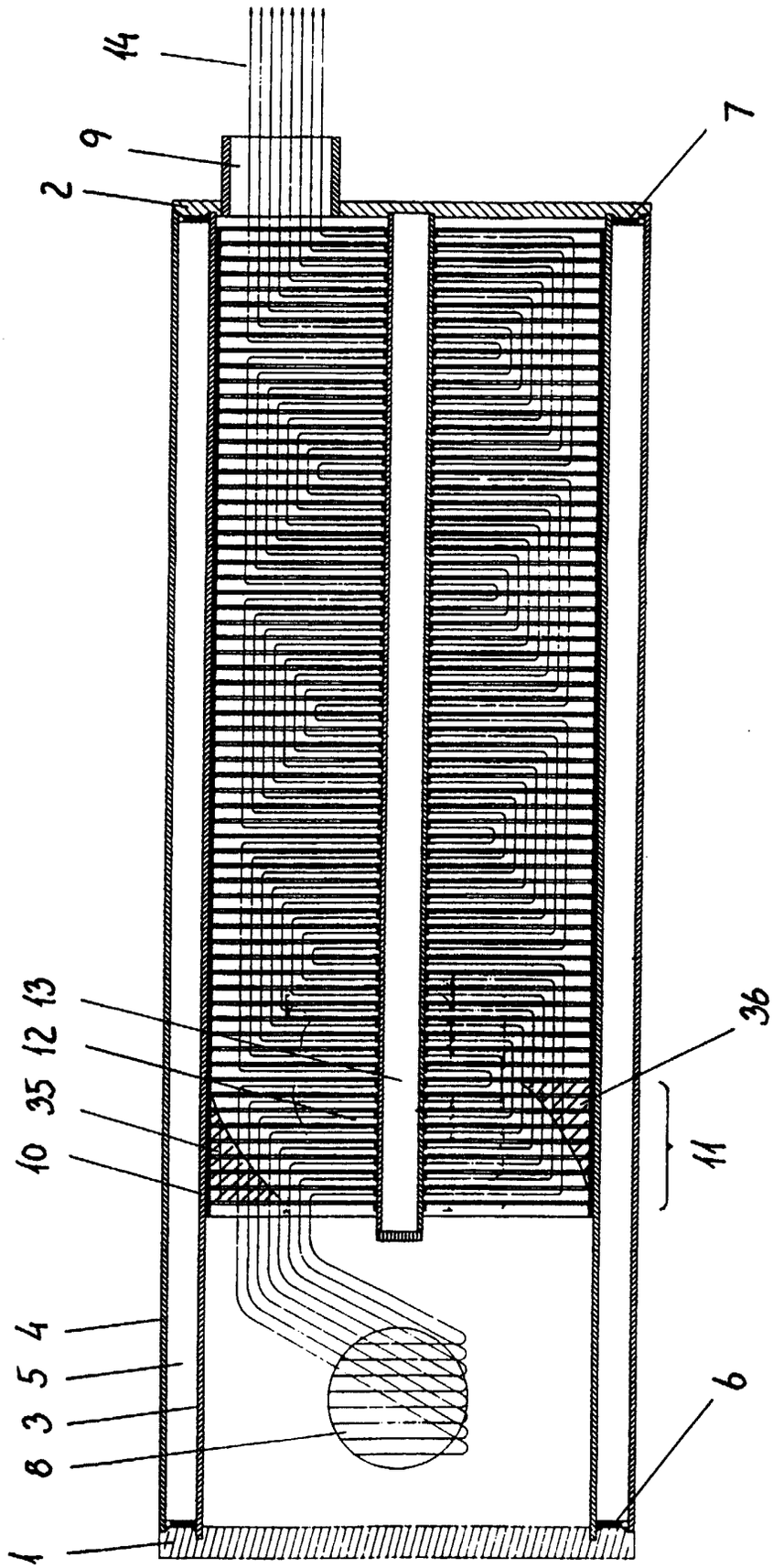

FIG. 1

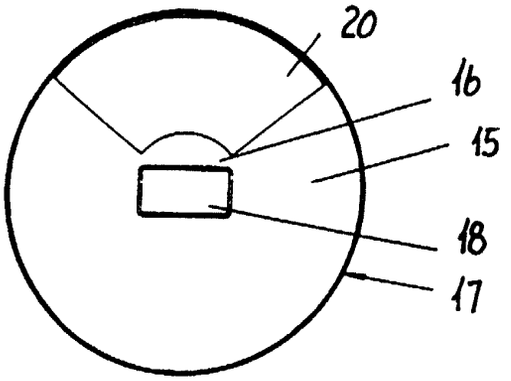

FIG. 2A

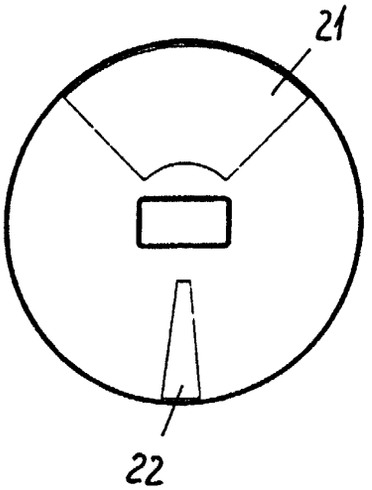

FIG. 2B

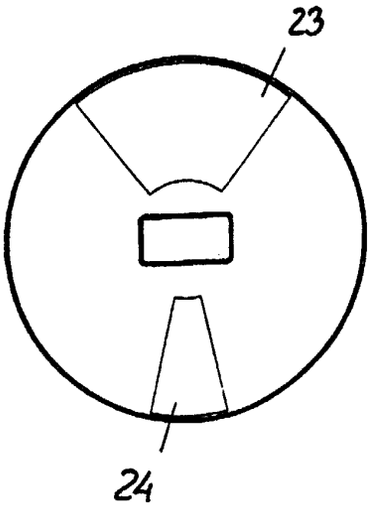

FIG. 2C

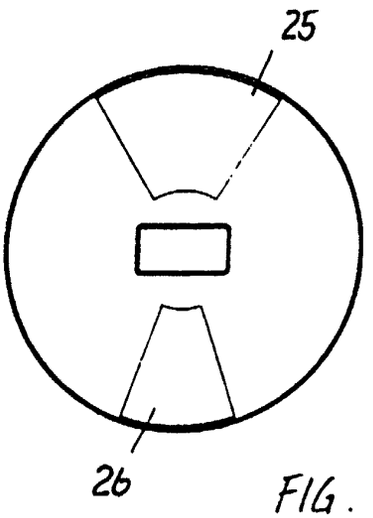

FIG. 2D

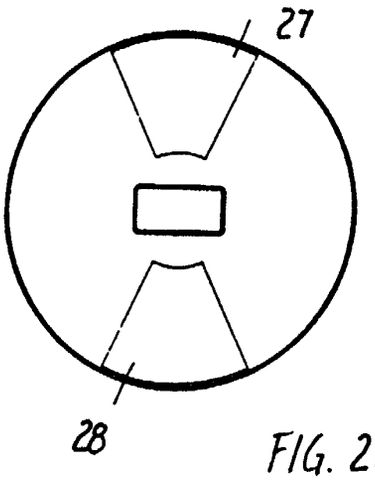

FIG. 2E

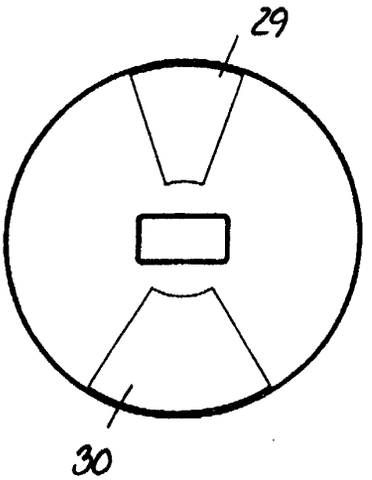

FIG. 2F

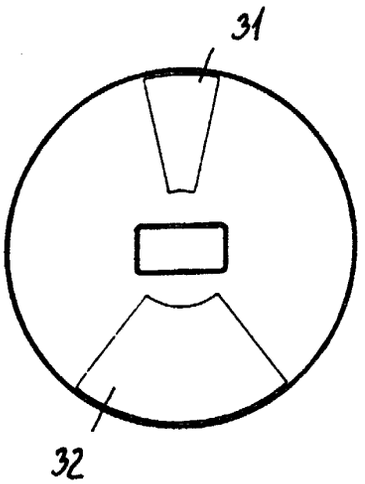

FIG. 2G

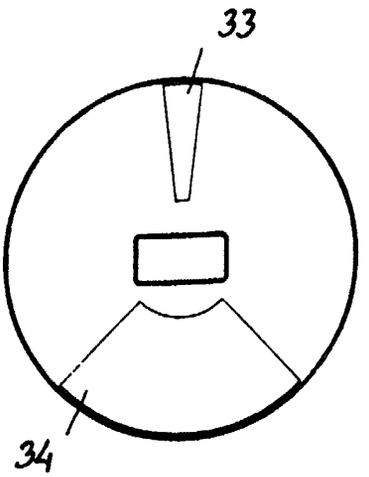

FIG. 2H

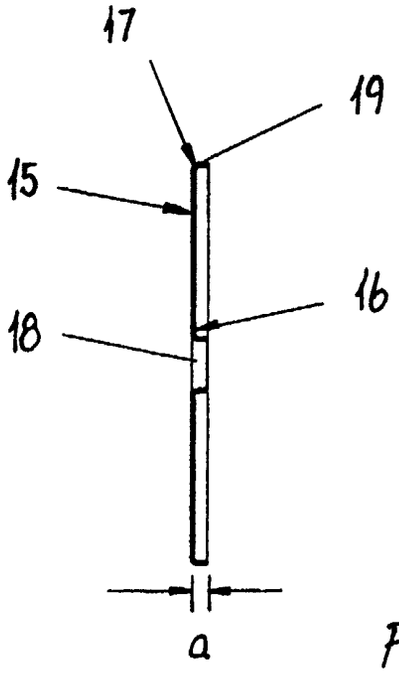

FIG. 3

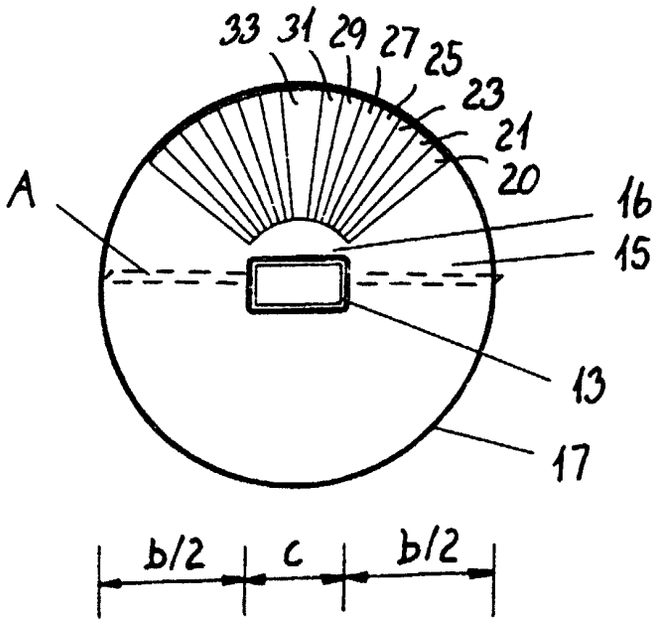

FIG. 4