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(54) **CLOTHES DRYING APPARATUS**

WÄSCHETROCKNER

SÈCHE-LINGE

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Description

Field of Invention

[0001] The present invention relates to a clothes drying apparatus comprising: a machine drum, having a rotary drum for accommodating clothes therein, and a condensing device, a fan, and a heating passage, connected to the machine drum, wherein the condensing device comprises at least one drying air passage in communication with the air circulation passage and at least one cooling air passage in communication with outside air and respectively adjacent to the drying air passage, and a heat exchange layer is disposed in the cooling air passage.

Related Art

[0002] A clothes drying apparatus of the generic type specified above is disclosed in European Patent Application No. EP 1 621 661 A2.

[0003] An existing clothes drying apparatus such as a clothes drying machine and a clothes washing and drying machine integrating clothes washing and drying functions usually has the following drying process. Under the action of a heating device, dry air is heated into dry hot air in a heating pipe, enters a clothes treating drum to perform heat exchange with wet clothes and carry away moisture in the clothes to form relatively wet hot air, and then enters a condensing device through an outlet disposed on the clothes treating drum. Through condensation of the condensing device, the moisture in the relatively wet hot air is condensed into water, and then discharged through a drain pipe, and the condensed air becomes relatively dry cold air, is reintroduced into the heating pipe under the action of a fan, and heated to form dry hot air and enters the next cycle. The process is repeated until the drying procedure ends.

[0004] Multiple condensing devices exist according to different condensing media. German Patent No. DE 37 38 031 C2 has disclosed a condensing device using air as the condensing medium. The condensing device using air as the condensing medium generally has at least one drying air passage and at least one cooling air passage in communication with outside air and respectively adjacent to the drying air passage, and a heat exchange layer is disposed in the cooling air passage. The relatively wet hot air discharged from the clothes treating drum flows through the drying air passage, and transfers heat to the heat exchange layer in the cooling air passage. When passing through the cooling air passage, the outside air takes away the heat on the heat exchange layer, and then is discharged from the condensing device.

[0005] It can be known through experiments that, the wet hot air passing through the drying air passage is usually non-uniformly distributed, so that the heat distributed on the heat exchange layer is also non-uniform, and thus the heat exchange efficiency is affected.

SUMMARY OF THE INVENTION

[0006] In view of the above problem, the present invention is directed to an improved clothes drying apparatus, which includes a condensing device having uniform heat dissipation and excellent condensation effect.

[0007] In order to achieve the above objective, the present invention is implemented through the following technical means. A clothes drying apparatus is provided, comprising: a machine drum, having a rotary drum for accommodating clothes therein; and a condensing device, a fan, and a heating passage, connected to the machine drum. The condensing device comprises at least one drying air passage in communication with the air circulation passage and at least one cooling air passage in communication with outside air and respectively adjacent to the drying air passage, and a heat exchange layer is disposed in the cooling air passage. Further, the condensing device, the fan, and the heating passage form an air circulation passage, and the heat exchange layer in the at least one cooling air passage is at least divided into a first part and a second part, and a heat dissipation area of the first part is larger than that of the second part.

[0008] The heat exchange layer, having regions of different heat dissipation areas, may be respectively corresponding to different circulating air flows, which achieves uniform heat distribution and dissipation effect and thus improves the condensation effect.

[0009] In a preferred implementation of the present invention, a division line is disposed between the first part and the second part, and the division line is approximately longitudinally distributed along the drying air passage. The distribution manner is corresponding to airflow distribution in the air circulation passage.

[0010] As a supplement of the present invention, when the circulating air in the air circulation passage passes through the drying air passage, a flow passing through a position corresponding to the first part of the heat exchange layer in the cooling air passage is larger than a flow passing through a position corresponding to the second part.

[0011] In another preferred implementation of the present invention, the condensing device includes a heat exchange passage assembly and a circulating air guiding device connected to the heat exchange passage assembly. The circulating air guiding device includes an inlet connected to the machine drum and an outlet connected to the heat exchange passage assembly. The inlet is near a first side of the cooling air passage, and is far from a second side of the cooling air passage. The second part of the heat exchange layer in the cooling air passage is near the first side of the cooling air passage, and the first part of the heat exchange layer in the cooling air passage is near the second side of the cooling air passage. Since the inlet of the circulating air guiding device is near the first side of the cooling air passage, when circulating air flows into the circulating air guiding device via its inlet and enters the drying air passage via its outlet, more air

flows are distributed near the second side of the cooling air passage, and the temperature is high; while fewer air flows are distributed near the first side of the cooling air passage, and the temperature is low. The above structure achieves uniform heat dissipation effect.

[0012] In another implementation of the present invention, neatly arranged heat exchange fins are disposed on the second part of the heat exchange layer in the cooling air passage, and alternately arranged heat exchange fins are disposed on the first part. The alternately arranged heat exchange fins have large resistance and variable airflow directions, so that the mobility thereof in all directions is good, the airflow distribution is more uniform, and the heat exchange area is large. The neatly arranged heat exchange fins have small resistance and invariable airflow directions, so that the heat exchange area is small.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present invention will become more fully understood from the detailed description given herein below for illustration only, and thus are not limitative of the present invention, and wherein:

FIG. 1 is a schematic structural view of a clothes drying apparatus;

FIG. 2 is a schematic view illustrating the operation principle of a condensing device in FIG. 1;

FIG. 3 is a schematic structural view of the condensing device in FIG. 1, in which a housing of a heat exchange layer is removed to show structural features of the heat exchange layer;

FIG. 4 is a schematic view of a second part of the heat exchange layer in FIG. 3; and

FIG. 5 is a schematic view of a first part of the heat exchange layer in FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

[0014] As shown in FIG. 1, a clothes drying apparatus 10 includes a machine drum 12, and a motor-driven rotary drum 14 that is capable of rotating is disposed in the machine drum 12. Clothes to be treated are dried in the rotary drum 14. The rotary drum 14 has many through holes (not shown) on a wall thereof, through which the rotary drum 14 and the machine drum 12 are in spatial communication with each other. The machine drum 12 is connected to a condensing device 16, a fan 18, and a heating passage 20 in sequence, so as to form an air circulation passage 22. An air flow for drying the clothes flows circularly in the air circulation passage 22 and carries away moisture in the clothes.

[0015] Specifically, the work flow of the clothes drying

apparatus 10 is as follows. Circulating air enters the rotary drum 14 after being heated by the heating passage 20, performs heat exchange with wet clothes therein to carry away moisture in the clothes, and forms relatively wet and hot air. The wet and hot circulating air enters the condensing device 16 from the machine drum 12. Through condensation of the condensing device 16, the moisture in the relatively wet and hot circulating air is condensed into water, flows into the machine drum 12, and finally is discharged through a drainage system 24. The condensed drying air is reintroduced into the heating passage 20 under the action of the fan 18, and enters the next cycle.

[0016] The condensing device 16 includes a cooling air inlet 34 and a cooling air outlet 36 in communication with the outside. Outside air is drawn by a blower 38 into the condensing device 16 through the cooling air inlet 34, performs heat exchange with the drying air passing through the condensing device 16 to carry away a part of heat of the drying air, and then is discharged through the cooling air outlet 36.

[0017] As shown in FIG. 2, the condensing device 16 includes a drying air passage 2 and a cooling air passage 4 isolated by a partition wall 8. The drying air passage 2 and the cooling air passage 4 are alternately distributed. A heat exchange layer 6 formed by a plurality of heat exchange fins is disposed in the cooling air passage 4. When flowing through the drying air passage 2, circulating air 3 transfers heat to the partition wall 8, and the partition wall 8 further transfers the heat to the heat exchange layer 6. Cold air 5 passes through the heat exchange layer 6, and takes away most heat on the heat exchange layer 6, so as to cool the wet hot air 3.

[0018] As shown in FIG. 3, the condensing device 16 includes a heat exchange passage assembly 40 and a circulating air guiding device 42 connected to the heat exchange passage assembly 40. The circulating air guiding device 42 includes an inlet 44 connected to the machine drum 12 and an outlet 46 connected to the heat exchange passage assembly 40. The inlet 44 is near a first side 48 of the cooling air passage 4, and is far from a second side 50 of the cooling air passage 4. Therefore, when the circulating air 3 flows into the circulating air guiding device 42 via the inlet 44 and enters the drying air passage 2 via its outlet 46, more air flows are distributed near the second side 50 of the cooling air passage 4, and the temperature is high; while fewer air flows are distributed near the first side 48 of the cooling air passage 4, and the temperature is low.

[0019] In order to uniformly dissipate the heat of the circulating air 3, the heat exchange layer 6 in the cooling air passage 4 is divided into a first part 54 and a second part 56 along a division line 52, and a heat dissipation area of the first part 54 is larger than that of the second part 56. The division line 52 is approximately longitudinally distributed along the drying air passage 2, the second part 56 is near the first side 48 of the cooling air passage 4, and the first part 54 is near the second side

50 of the cooling air passage 4.

[0020] It can be known through experiments that, in the condensing device 16 of the above structure, the flow of the circulating air 3 distributed near the second side 50 of the cooling air passage 4 in the drying air passage 2 accounts about 3/5, and the flow distributed near the first side 48 of the cooling air passage 4 accounts about 2/5. Therefore, the first part 54 of the heat exchange layer 6 in the cooling air passage 4 accounts about 3/5 of a total area of the heat exchange layer 6, and the second part 56 of the heat exchange layer 6 in the cooling air passage 4 accounts about 2/5 of the total area of the heat exchange layer 6.

[0021] In other embodiments, if a distributed direction and position of the inlet 44 of the circulating air guiding device 42 changes, the distribution of the circulating air 3 in the drying air passage 2 also changes. The distribution form and proportion of the first part 54 and the second part 56 of the heat exchange layer 6 are designed according to specific distribution of the circulating air 3 in the drying air passage 2. For example, if the inlet 44 of the circulating air guiding device 42 is located at the bottom near a center of the drying air passage 2, a flow of the circulating air 3 distributed in the center of the drying air passage 2 is larger; therefore, the part with a larger heat dissipation area of the heat exchange layer 6 should be distributed in the center, while the part with a smaller heat dissipation area should be distributed at both sides.

[0022] In one of the embodiments, as shown in FIG. 4 and FIG. 5, neatly (as in even or straight) arranged heat exchange fins 58 are disposed on the second part 56 of the heat exchange layer 6 in the cooling air passage 4, and alternately arranged heat exchange fins 58 are disposed on the first part 54. The heat exchange fins 58 are made of heat conducting materials, and had better have regular spatial shapes, so that air can easily flow in one direction. The alternately arranged heat exchange fins 58 have large resistance and variable airflow directions, so that the mobility thereof in all directions is good, the airflow distribution is more uniform, and the heat exchange area is large. The neatly arranged heat exchange fins 58 have small resistance and invariable airflow directions, so that the heat exchange area is small.

[0023] In addition to the above embodiments, the heat exchange layer 6 may have many other specific embodiments. For example, the first part 54 of the heat exchange layer 6 has a larger contact area with air than the second part 56 per unit volume, such as the heat exchange fins are folded more densely, or heat exchange wires are used in the first part 54.

[0024] The above descriptions are merely preferred embodiments of the present invention, and the present invention may have other embodiments. For persons of ordinary skill in the art, equivalent changes made under the teachings of the present invention shall fall within the scope defined by the claims of the present invention.

Claims

1. A clothes drying apparatus (10), comprising:

a machine drum (12), having a rotary drum (14) for accommodating clothes therein; and a condensing device (16), a fan (18), and a heating passage (20), connected to the machine drum (12),

wherein the condensing device (16) comprises at least one drying air passage (2) in communication with an air circulation passage (22) and at least one cooling air passage (4) in communication with outside air and respectively adjacent to the drying air passage (2), and a heat exchange layer (6) is disposed in the cooling air passage (4),

characterized in that:

the condensing device (16), the fan (18), and the heating passage (20) form the air circulation passage (22), and the heat exchange layer (6) in the at least one cooling air passage (4) is at least divided into a first part (54) and a second part (56), and a heat dissipation area of the first part (54) is larger than that of the second part (56).

2. The clothes drying apparatus (10) according to claim 1, wherein a division line (52) is disposed between the first part (54) and the second part (56), and the division line (52) is approximately longitudinally distributed along the drying air passage (2).

3. The clothes drying apparatus (10) according to claim 1 or 2, wherein when circulating air (3) in the air circulation passage (22) passes through the drying air passage (2), a flow passing through a position corresponding to the first part (54) of the heat exchange layer (6) in the cooling air passage (4) is larger than a flow passing through a position corresponding to the second part (56).

4. The clothes drying apparatus (10) according to claim 3, wherein the condensing device (16) comprises a heat exchange passage assembly (40) and a circulating air guiding device (42) connected to the heat exchange passage assembly (40), the circulating air guiding device (42) comprises an inlet (44) connected to the machine drum (12) and an outlet (46) connected to the heat exchange passage assembly (40), the inlet (44) is near a first side (48) of the cooling air passage (4), and is far from a second side (50) of the cooling air passage (4), the second part (56) of the heat exchange layer (6) in the cooling air passage (4) is near the first side (48) of the cooling air passage (4), and the first part (54) of the heat ex-

change layer (6) in the cooling air passage (4) is near the second side (50) of the cooling air passage (4).

5. The clothes drying apparatus (10) according to claim 4, wherein the first part (54) of the heat exchange layer (6) in the cooling air passage (4) occupies about 3/5 of a total area of the heat exchange layer (6), and the second part (56) occupies about 2/5 of the total area of the heat exchange layer (6).
6. The clothes drying apparatus (10) according to claim 3, wherein neatly arranged heat exchange fins (58) are disposed on the second part (56) of the heat exchange layer (6) in the cooling air passage (4), and alternately arranged heat exchange fins (58) are disposed on the first part (54).

Patentansprüche

1. Wäschetrockner (10), umfassend:

eine Maschinentrommel (12) mit einer Drehtrommel (14) zum Aufnehmen von Kleidung darin;

und

eine Kondensiervorrichtung (16), ein Gebläse (18) und einen Heizkanal (20), der mit der Maschinentrommel (12) verbunden ist, wobei die Kondensiervorrichtung (16) mindestens einen Trocknungsluftkanal (2) umfasst, der mit einem Luftzirkulationskanal (22) kommuniziert, und mindestens einen Kühlluftkanal (4), der mit der Außenluft kommuniziert und entsprechend benachbart zu dem Trocknungsluftkanal (2) angeordnet ist, und eine Wärmetauscherschicht (6), die in dem Kühlluftkanal (4) angeordnet ist,

dadurch gekennzeichnet, dass:

die Kondensiervorrichtung (16), das Gebläse (18) und der Heizkanal (20) den Luftzirkulationskanal (22) bilden, und dadurch, dass

die Wärmetauscherschicht (6) in dem mindestens einen Kühlluftkanal (4) mindestens in einen ersten Teil (54) und einen zweiten Teil (56) aufgeteilt ist, und ein Wärmeableitungsbereich des ersten Teils (54) größer als der des zweiten Teils (56) ist.

2. Wäschetrockner (10) nach Anspruch 1, wobei eine Trennlinie (52) zwischen dem ersten Teil (54) und dem zweiten Teil (56) angeordnet ist, und wobei die Trennlinie (52) etwa längs entlang des Trocknungsluftkanals (2) verteilt ist.
3. Wäschetrockner (10) nach Anspruch 1 oder 2, wo-

bei, wenn zirkulierende Luft (3) in dem Luftzirkulationskanal (22) den Trocknungsluftkanal (2) durchläuft, eine Strömung, die durch eine dem ersten Teil (54) der Wärmetauscherschicht (6) im Kühlluftkanal (4) entsprechenden Position durchläuft, größer ist, als eine Strömung, die durch eine dem zweiten Teil (56) entsprechenden Position durchläuft.

4. Wäschetrockner (10) nach Anspruch 3, wobei die Kondensiervorrichtung (16) eine Wärmetauscherkanalanordnung (40) und eine Zirkulationsluft-Führungsvorrichtung (42) umfasst, die mit der Wärmetauscherkanalanordnung (40) verbunden ist, wobei die Zirkulationsluft-Führungsvorrichtung (42) einen Einlass (44) umfasst, der mit der Maschinentrommel (12) verbunden ist, und einen Auslass (46), der mit der Wärmetauscherkanalanordnung (40) verbunden ist,

wobei der Einlass (44) in der Nähe einer ersten Seite (48) des Kühlluftkanals (4) und entfernt von einer zweiten Seite (50) des Kühlluftkanals (4) angeordnet ist,

wobei der zweite Teil (56) der Wärmetauscherschicht (6) in dem Kühlluftkanal (4) in der Nähe der ersten Seite (48) des Kühlluftkanals (4) angeordnet ist, und

wobei der erste Teil (54) der Wärmetauscherschicht (6) in dem Kühlluftkanal (4) in der Nähe der zweiten Seite (50) des Kühlluftkanals (4) angeordnet ist.

5. Wäschetrockner (10) nach Anspruch 4, wobei der erste Teil (54) der Wärmetauscherschicht (6) in dem Kühlluftkanal (4) etwa 3/5 des Gesamtbereichs der Wärmetauscherschicht (6) einnimmt und der zweite Teil (56) etwa 2/5 des Gesamtbereichs der Wärmetauscherschicht (6) einnimmt.

6. Wäschetrockner (10) nach Anspruch 3, wobei präzise angeordnete Wärmetauscherrippen (58) in dem zweiten Teil (56) der Wärmetauscherschicht (6) in dem Kühlluftkanal (4) angeordnet sind und abwechselnd angeordnete Wärmetauscherrippen (58) in dem ersten Teil (54) angeordnet sind.

Revendications

1. Appareil pour sécher le linge (10), comprenant : un tambour de machine (12) possédant un tambour rotatif (14) pour accueillir le linge et un dispositif condenseur (16), un ventilateur (18) et un passage chauffant (20), connecté au tambour de machine (12), dans lequel le dispositif condenseur (16) comprend au moins un passage d'air de séchage (2) en communication avec un passage de circulation d'air (22) et au moins un passage d'air de refroidissement (4) en communication avec l'air extérieur et respectivement adjacent au passage d'air de séchage (2),

et un échangeur de chaleur en couches (6) est disposé dans le passage d'air de refroidissement (4), **caractérisé en ce que** : le dispositif condenseur (16), le ventilateur (18) et le passage chauffant (20) constituent le passage de circulation d'air (22) et l'échangeur de chaleur en couches (6) dans l'au moins un passage d'air de refroidissement (4) est au moins divisé en une première partie (54) et une deuxième partie (56) et une zone de dissipation de la chaleur de la première partie (54) est plus grande que celle de la deuxième partie (56).

2. Appareil pour sécher le linge (10) selon la revendication 1, dans lequel une ligne de division (52) est située entre la première partie (54) et la deuxième partie (56) et la ligne de division (52) est approximativement répartie longitudinalement le long du passage d'air de séchage (2).
3. Appareil pour sécher le linge (10) selon la revendication 1 ou 2 dans lequel lorsque de l'air de circulation (3) se trouve dans le passage de circulation d'air (22), il traverse le passage d'air de séchage (2), un flux passant à travers une position correspondant à la première partie (54) de l'échangeur de chaleur en couches (6) dans le passage d'air de refroidissement (4) étant plus grand qu'un flux passant à travers une position correspondant à la deuxième partie (56).
4. Appareil pour sécher le linge (10) selon la revendication 3, dans lequel le dispositif condenseur (16) comprend un assemblage de passage d'échange de chaleur (40) et un dispositif de guidage d'air de circulation (42) connecté à l'assemblage de passage d'échange de chaleur (40), dispositif de guidage d'air de circulation (42) comprenant une entrée (44) connectée au tambour de machine (12) et une sortie (46) connectée à l'assemblage de passage d'échange de chaleur (40), l'entrée (44) étant proche d'un premier côté (48) du passage d'air de refroidissement (4) et éloignée d'un deuxième côté (50) du passage d'air de refroidissement (4), la deuxième partie (56) de l'échangeur de chaleur en couches (6) dans le passage d'air de refroidissement (4) étant proche du premier côté (48) du passage d'air de refroidissement (4) et la première partie (54) de l'échangeur de chaleur en couches (6) dans le passage d'air de refroidissement (4) étant proche du deuxième côté (50) du passage d'air de refroidissement (4).
5. Appareil pour sécher le linge (10) selon la revendication 4, dans lequel la première partie (54) de l'échangeur de chaleur en couches (6) dans le passage d'air de refroidissement (4) occupe environ 3/5 d'une surface totale de l'échangeur de chaleur en couches (6) et la deuxième partie (56) occupe environ 2/5 de la surface totale de l'échangeur de chaleur en couches (6).

6. Appareil pour sécher le linge (10) selon la revendication 3, dans lequel des ailettes d'échange de chaleur (58) disposées avec soin sont situées sur la deuxième partie (56) de l'échangeur de chaleur en couches (6) dans le passage d'air de refroidissement (4) et des ailettes d'échange de chaleur (58) disposées alternativement sont situées sur la première partie (54).

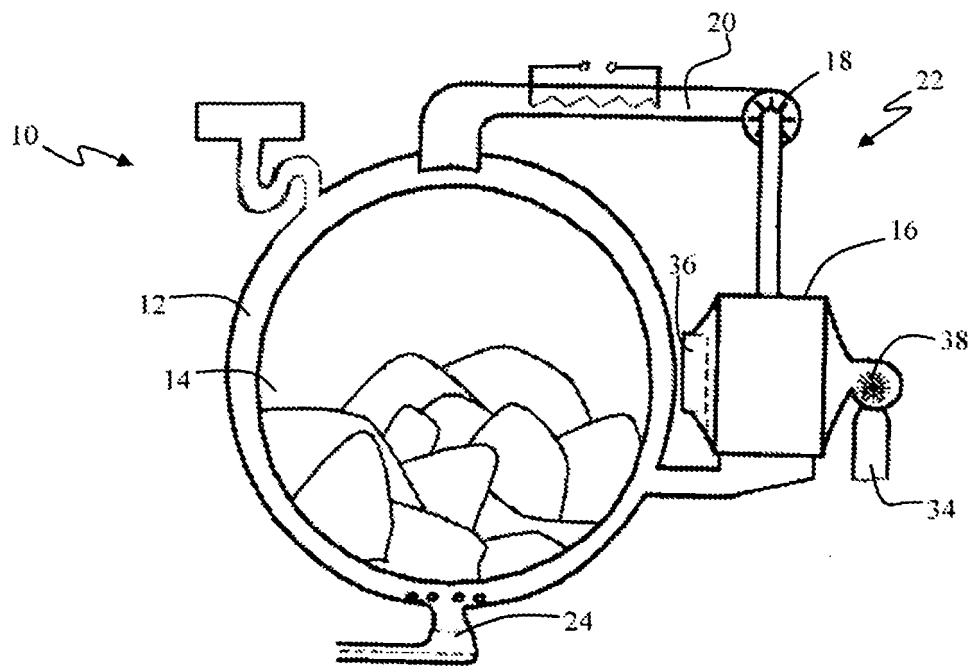


FIG. 1

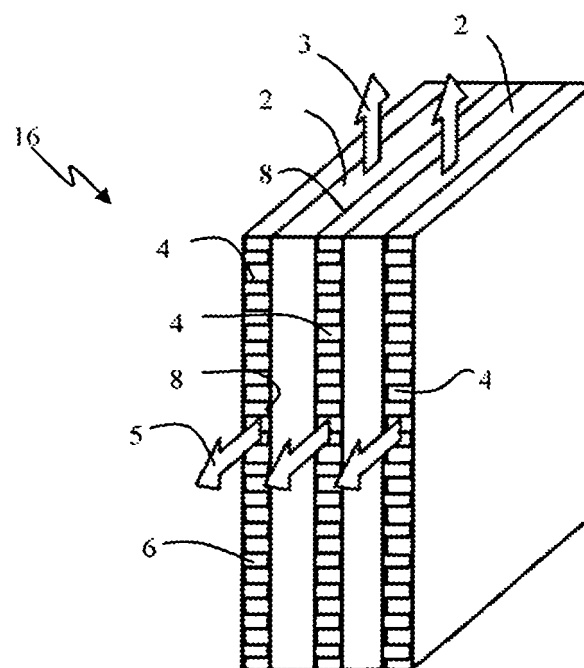


FIG. 2

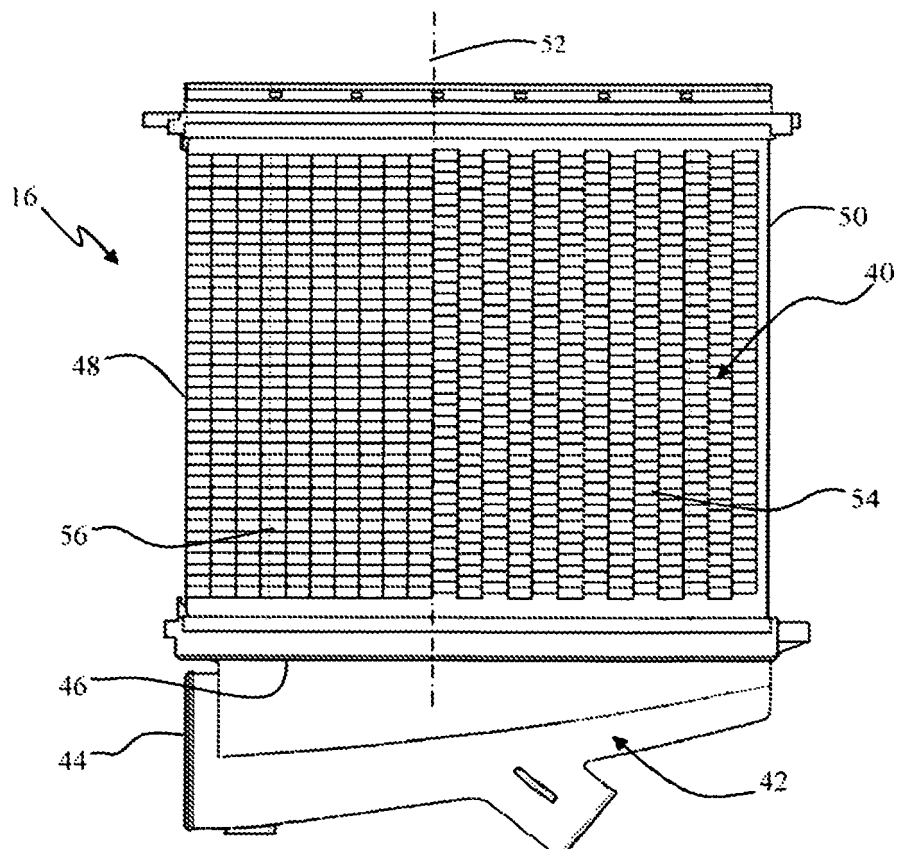


FIG. 3

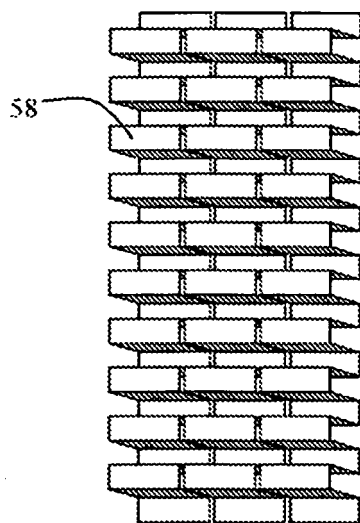


FIG. 4

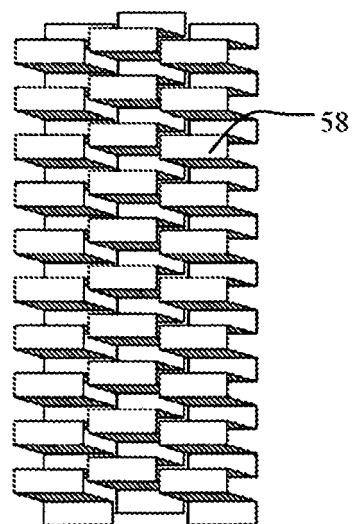


FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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