



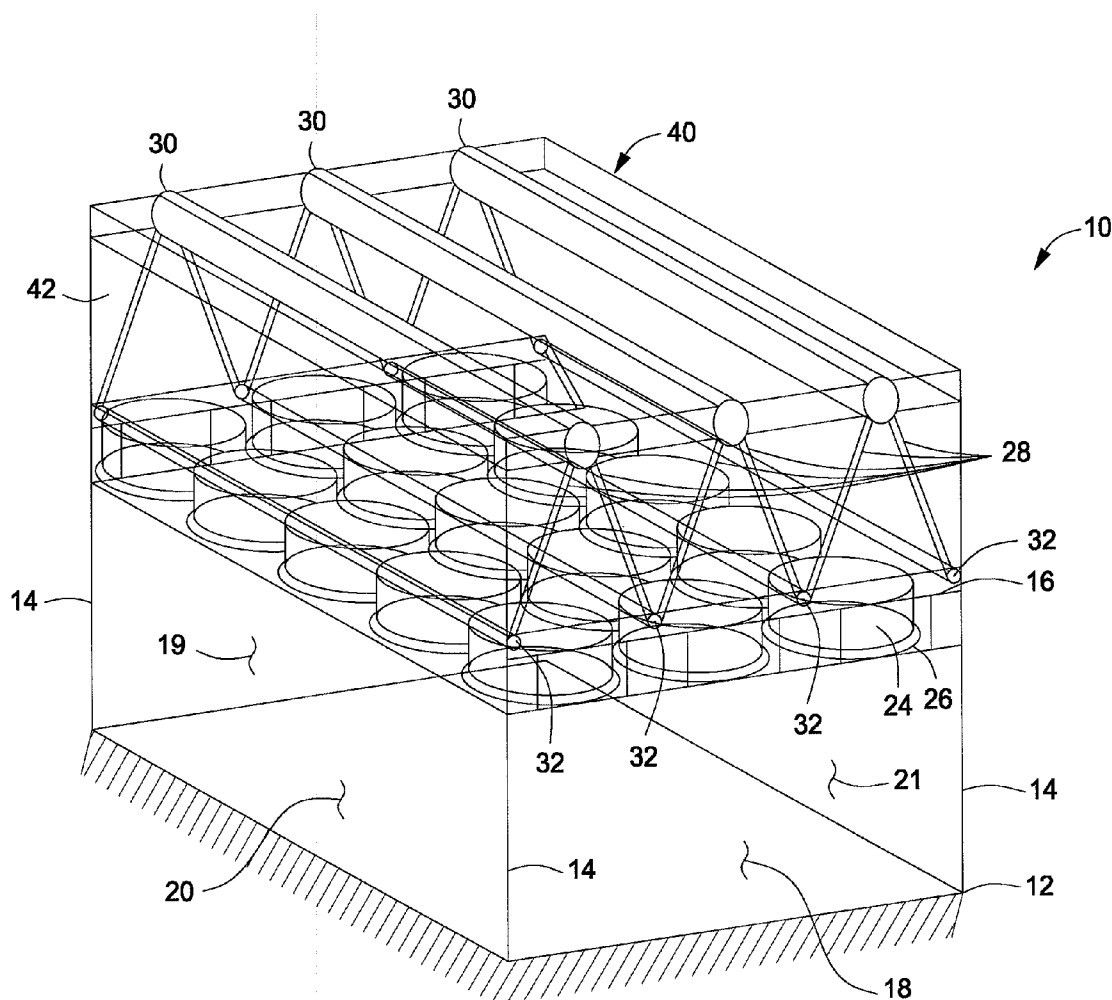
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(19) **United States**(12) **Patent Application Publication****Vouche**(10) **Pub. No.: US 2009/0220334 A1**(43) **Pub. Date: Sep. 3, 2009**(54) **FAN SHROUD FOR HEAT EXCHANGE
TOWER FANS**(22) Filed: **Feb. 28, 2008****Publication Classification**(75) Inventor: **Michel Vouche, Brussels (BE)**(51) **Int. Cl.**
F04D 29/66 (2006.01)(52) **U.S. Cl.** **415/119**

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BAKER & HOSTETLER LLP**WASHINGTON SQUARE, SUITE 1100, 1050****CONNECTICUT AVE. N.W.****WASHINGTON, DC 20036-5304 (US)**(57) **ABSTRACT**

A heat exchange tower which has at least one fan having fan blades and a fan shroud, and the fan shroud has a sound absorbing portion including an outer ring structure and a sound absorbing material disposed inside the outer ring structure and outside of the circle of rotation of the fan blades. A flared inlet portion is provided leading to the sound absorbing portion.

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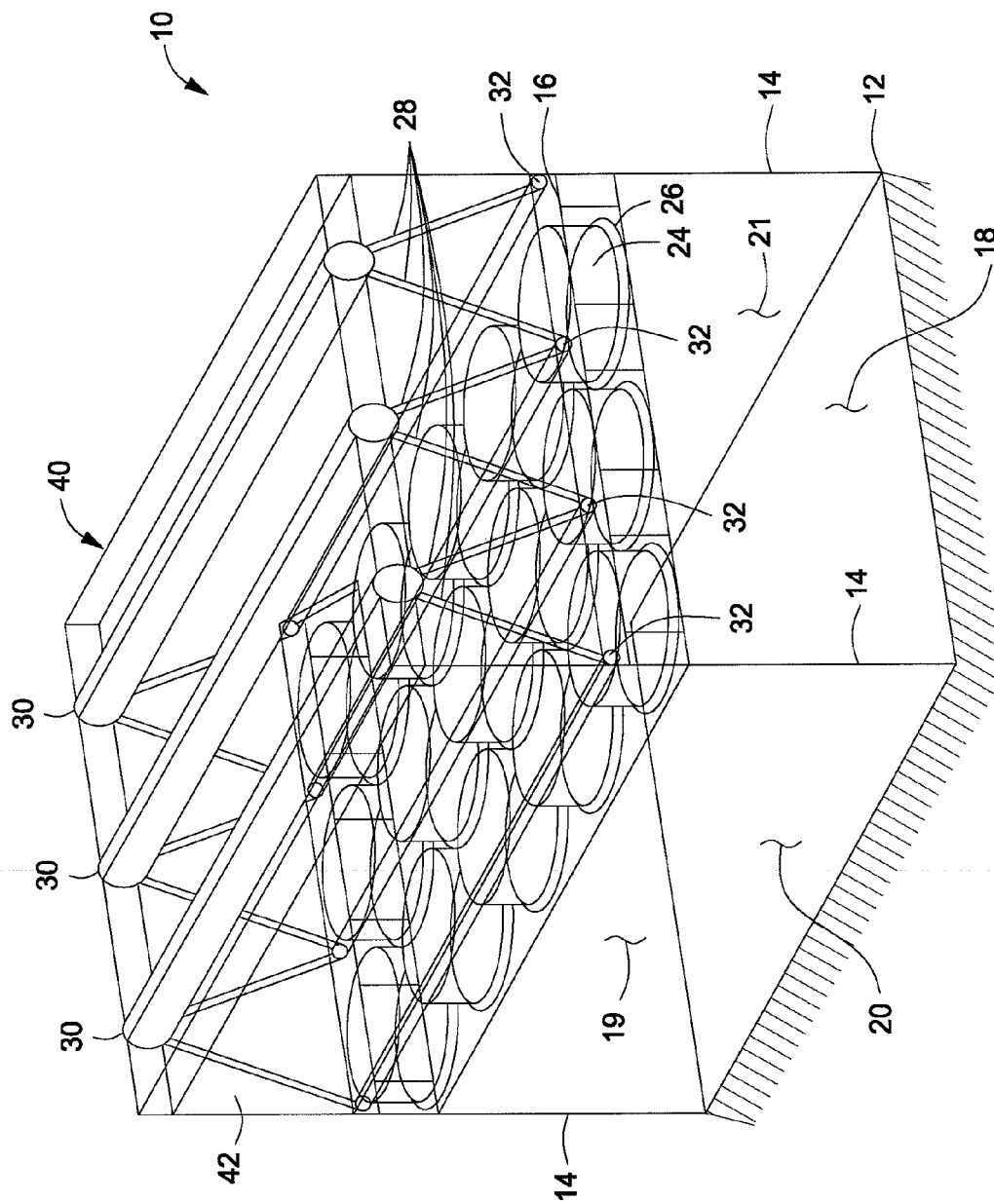


FIG. 1

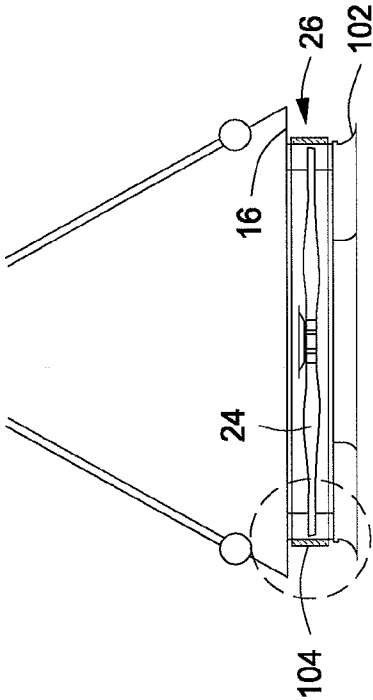


FIG. 3

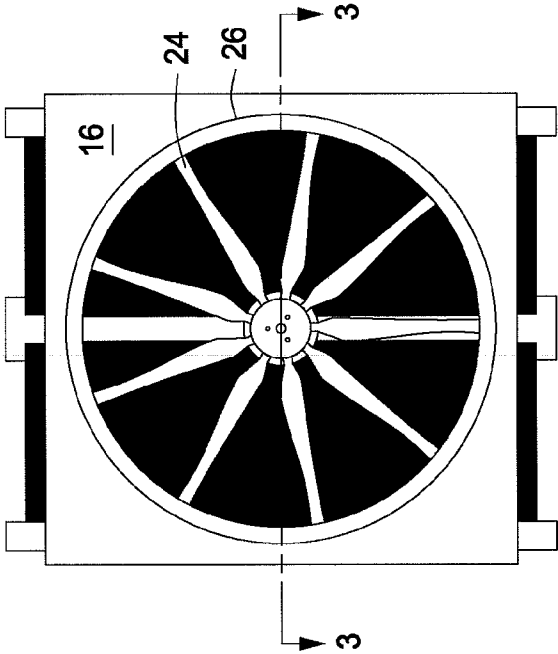


FIG. 2

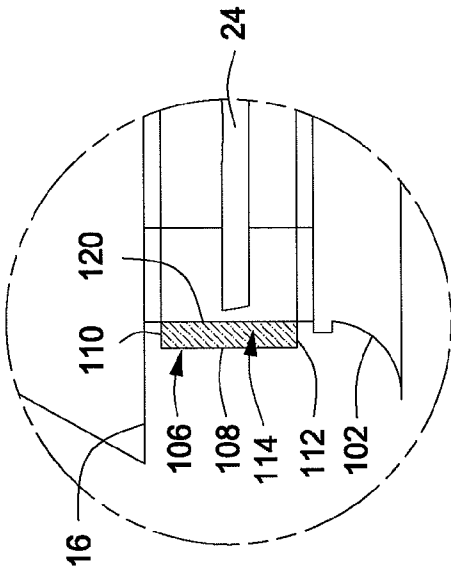


FIG. 4

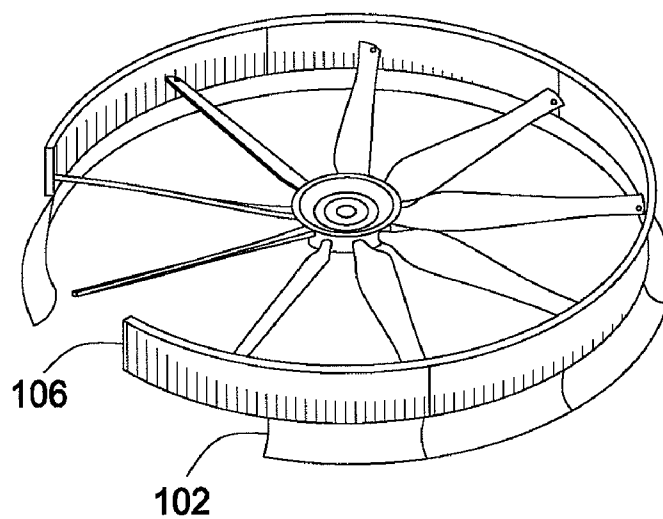


FIG. 5

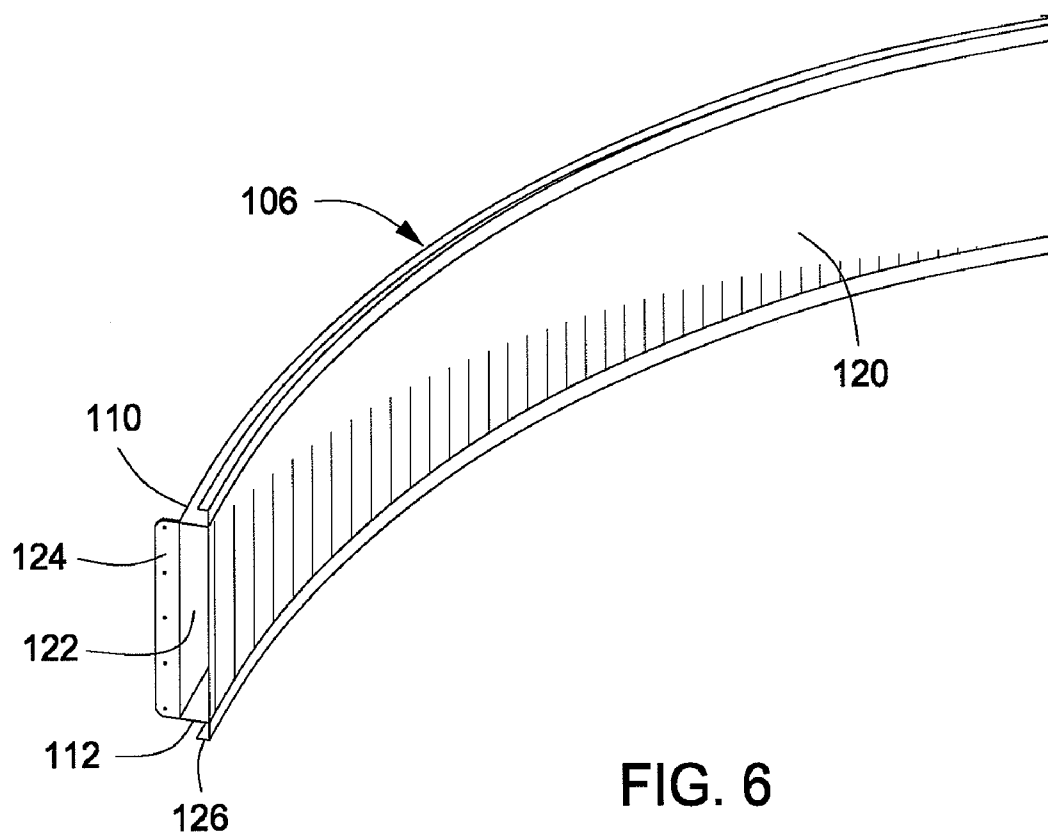


FIG. 6

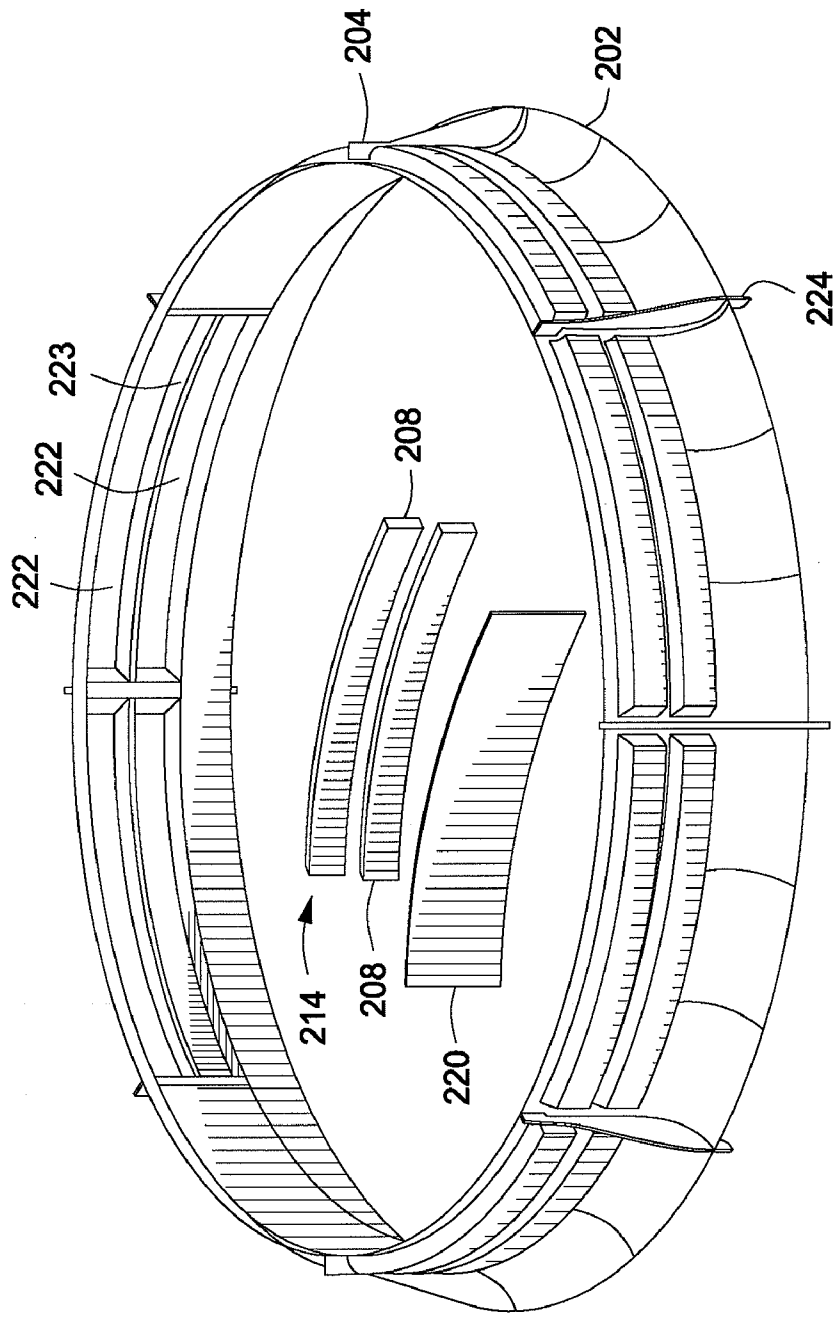


FIG. 7

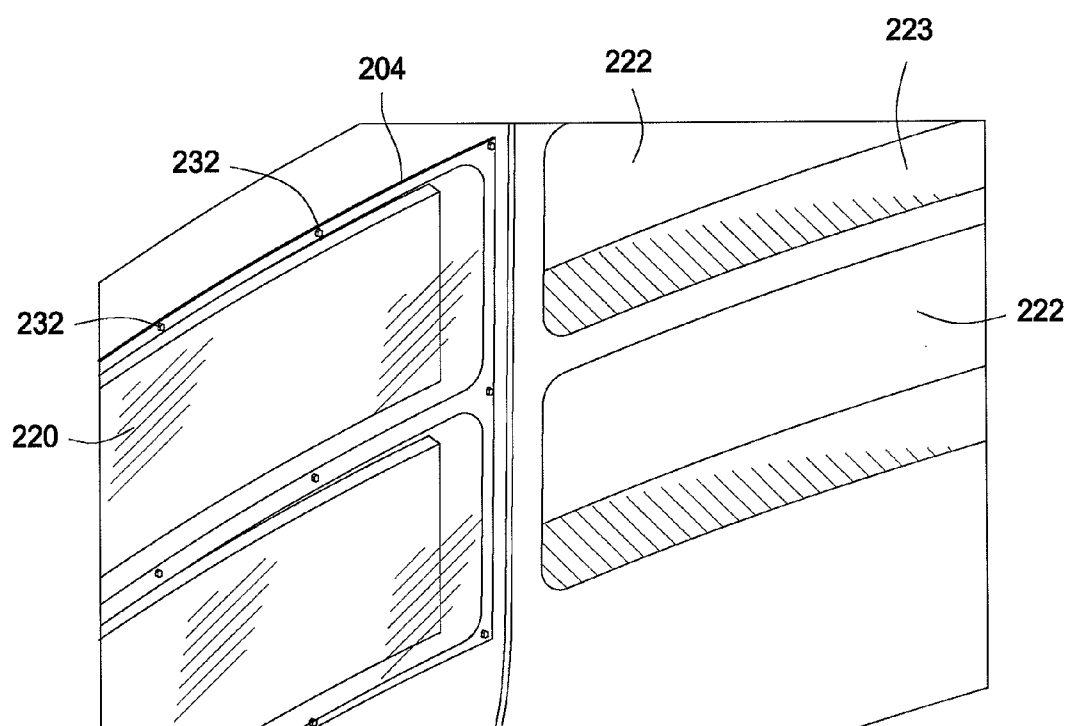


FIG. 8

FAN SHROUD FOR HEAT EXCHANGE TOWER FANS

FIELD OF THE INVENTION

[0001] The invention relates to the field of heat exchange towers, and more particularly relates to the field of fans used to move air through heat exchange towers, including industrial cooling towers, industrial heating towers, and air cooled steam condensers.

BACKGROUND OF THE INVENTION

[0002] A wide variety of heat exchange towers are known in the industry. These heat exchange towers include, for example, so-called industrial cooling towers, which are used to cool warm water by industrial or other processes. These cooling towers typically have a liquid that is sprayed from a top inside the tower, and falls over a media such as, for example, splash bars or a pack of spaced apart thin film sheets. Air is typically drawn through the tower, either sideways across the tower, upwardly through the tower, or a combination thereof, and interacts with the falling liquid. The falling liquid is warmer than the ambient air, and thus is cooled by this process and falls into a collection basin at the bottom of the tower. Another type of heat exchange tower is a heating tower which may be used, for example, for the vaporization of liquefied natural gas.

[0003] Yet another type of tower is an air cooled condenser (ACC) tower. Such a tower is typically a large box-like structure having an open lower or side frame. The open frame may be closed off on some of its sides. The frame supports a deck having a series of fans which blow air upward so that the air is drawn in through the open sides of the tower and is forced upward by the fans. Above the fans the tower supports a series of condenser coils. In some examples, a plurality of steam supply header tubes run lengthwise on the top of the tower and dispense steam downward into angled downwardly extending condenser coils. Water is heated in a boiler to create steam, which is then sent to a high pressure end of a turbine to create work (via change in energy of the steam). The steam at the low pressure end of the turbine then is condensed by the condenser to create a vacuum that pulls the steam through the turbine. At the bottom of the angled downwardly extending condenser coils is a series of collection header tubes which receives condensed fluid and exits it from the tower. The entirety of the condenser coils is usually located above the fans. Air is exhausted out the open top of the tower past the steam supply header tubes. A deck of the fans is added below the coils to provide a greater volume of air flow. The deck typically has a number of fans spaced in a grid-like arrangement, each surrounded by a fan shroud. Other terms for fan shroud are fan inlet bell or fan casing. An example of a different ACC tower is described in U.S. Patent Publication No. 2006/0243430.

[0004] All of the above types of towers are suitable for various applications and have found wide acceptance in industry. However, it is often desirable in such tower installations to reduce the noise or sound that is produced by the tower. One major cause of noise or sound in some towers is noise that is generated by the operation of the fans themselves. In the case of ACCs, a relatively large number of fans is often present, and thus the desire to reduce the noise asso-

ciated with each fan is sometimes even greater than with other types of heat exchange towers.

SUMMARY OF THE INVENTION

[0005] In one aspect, a heat exchange tower comprises at least one fan having fan blades with outer tips rotating in a circle of rotation, and a fan shroud, the fan shroud comprising an outer ring structure, and a sound absorbing material mounted to the outer ring surface and disposed radially inside the outer ring structure and outside of the circle of rotation of the tips of the fan blades.

[0006] In another aspect, a heat exchange tower also comprises at least one fan having fan blades with outer tips rotating in a circle of rotation, and a fan shroud, the fan shroud which has an outer supporting means and a sound absorbing means mounted to the outer supporting means disposed radially inside the outer supporting means and outside of the circle of rotation of the tips of the fan blades.

[0007] In yet another aspect, a heat exchange tower has at least one fan having fan blades with outer tips rotating in a circle of rotation and a fan shroud, the fan shroud comprising an outer ring structure formed of at least one molded section, the section forming at least one pocket and a sound absorbing material disposed inside the pocket and radially outside of the circle of rotation of the tips of the fan blades.

[0008] Another aspect provides a method for reducing sound emitted by a heat exchange tower, the tower having at least one fan blade with outer tips rotating in a circle of rotation, and a fan shroud surrounding the circle of rotation of the tips, comprising the step of providing a sound absorbing material on an inner surface of the shroud between the inner surface of the shroud and the circle of rotation of the blade tips.

[0009] Still another aspect provides an air cooled condenser which has a plurality of condenser coils, a fan deck disposed below the condenser coils, the fan deck comprising a plurality of fans having fan blades with outer tips rotating in a circle of rotation, and a plurality of fan shrouds each surrounding a respective fan, each fan shroud comprising an outer ring structure; and a sound absorbing material mounted to the outer ring surface and disposed radially inside the outer ring structure and outside of the circle of rotation of the tips of the fan blades.

[0010] There has thus been outlined, rather broadly, certain embodiments of the invention in order that the detailed description thereof herein may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional embodiments of the invention that will be described below and which will form the subject matter of the claims appended hereto.

[0011] In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of embodiments in addition to those described and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein, as well as the abstract, are for the purpose of description and should not be regarded as limiting.

[0012] As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other struc-

tures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a schematic perspective view of an air cooled condenser having a fan deck with a plurality of fan shrouds.

[0014] FIG. 2 is a bottom view of a fan surrounded by a fan shroud.

[0015] FIG. 3 is a sectional view of a fan and a fan shroud taken through line 3-3 in FIG. 2, according to the first preferred embodiment of the invention.

[0016] FIG. 4 is a detailed view of a fan shroud taken through the detail circle of FIG. 3.

[0017] FIG. 5 is a slightly cutaway perspective view of the fan shroud.

[0018] FIG. 6 is a cutaway perspective view of the fan shroud shown in FIG. 5.

[0019] FIG. 7 is a somewhat exploded view of a fan shroud according to a second preferred embodiment of the invention.

[0020] FIG. 8 is a cutaway detail view of the fan shroud of FIG. 7.

DETAILED DESCRIPTION

[0021] Some embodiments of the present invention provide a fan shroud for heat exchange tower fans, including a noise reducing material that can reduce fan noise coming from the heat exchange tower. In some embodiments, the fan shroud includes an outer ring structure and the sound absorbing material is disposed inside the outer ring structure and outside the circle of rotation of the tips of the fan blades. Some preferred embodiments of the invention will now be described with reference to the drawing figures, in which like reference numerals refer to like parts throughout.

[0022] Turning now to FIG. 1, an air cooled condensing (ACC) tower 10 is shown. The tower includes a base 12 which rests on the ground and lower framework 14 which supports a fan deck 16. The lower framework 14 is shown simply as being legs at the corner of the tower. However, it will be appreciated by one skilled in the art that such a frame 14 is typically an internal lattice framework having columns and girts interconnected with each other to form an open frame. All four sides of the frame may be left open below the fan deck 16, or in some instances two of the opposed sides may each have a closed wall. Examples of an ACC illustrated herein will be described in the context of having the two end walls labeled 18 and 19 as being closed and the two sides labeled 20 and 21 as being open. However, it will be appreciated may have any number of open or closed sides beneath the fan deck 16.

[0023] The fan deck 16 is a support structure which typically supports a plurality of individual fans 24 (blades not shown in FIG. 1 for clarity of illustration), each having their own fan shroud 26 associated therewith. The fan shrouds 26 are discussed in further detail below. The fans 24 blow air upward past a series of angled condenser tube coil structures 28. The coils 28 are elongated coils generally forming a planar sheet-like structure which air can pass through. The coils 28 receive steam from a plurality of steam supply headers 30. The steam supply headers lead into the coils 28 and

steam/water falls downward vertically through the coils 28 and is cooled by heat exchange with the ambient air outside the coils 28. The steam condenses into water which is collected in lower water collection headers 32 and discharged from the tower.

[0024] An upper frame structure 40 is typically provided to provide overall structural support to the area having the supply headers 30, condenser coils 28, and water headers 32. The coil and header pieces build into an upper superstructure. The frame structure 40 is simply framing for the casing. The casing may extend to approximately the bottom of the steam header or may extend some modest distance above the steam header. This upper frame 40 typically will have all four sides closed by solid or generally non-porous side walls or coverings 42 on all four sides. It will be appreciated that in FIG. 1 many solid items such as the side walls are shown being transparent so that an inner view of the tower 10 can be provided.

[0025] FIGS. 2-6 show a first preferred embodiment of the present invention. In this embodiment the fan shroud 26 includes an eased or flared, inwardly tapered inlet section 102, as well as a noise absorbing section 104, which is disposed at the axial position of the fans, and surrounds the fan tips as they rotate.

[0026] The noise absorbing section 104 is adapted to reduce sound coming from the fan tips in particular, and the fan in general. The eased or flared inlet section 102 may be of a relatively conventional construction and can be, for example, made of segments of molded fiberglass material, or may be in sections or a continuous piece of rolled steel. The noise absorbing section 104 includes as some portion thereof a sound absorbing material 114. Various arrangements for mounting the sound absorbing material 114 are discussed further herein. Sound absorbing materials may comprise any known or future discovered sound absorbing material, such as, for example, fiberglass batting or foam. Also, the sound absorbing material may comprise an irregular shaped surface material. By way of example, only some suitable materials include acoustical foam such as that made by SONEX®, or open and closed all flexible polyurethane, polyimide, melamine and other absorption foams, or flexible external viscoelastic and constrained layer products available from SOUNDcoat®. Simple fiberglass batting such as used for insulation is also suitable. Also, besides the above and other passive materials, locally active materials may be employed. Combinations of different sound absorbing materials may also be used. Further, the sound absorbing material may span entirely around the circumference of the noise absorbing portion 104, may span across arcuate portions of the noise absorbing portion 104, and may span either part of the entire height of the noise absorbing portion 104. Further, although the noise absorbing portion 104 is referred to herein for convenience as having a straight side, it may of course also have either or both of its inner and outer surfaces being a somewhat convex, or somewhat concave shape, or may have an undulating shape. Further, the noise absorbing portion 104 may simply be a truncated cone flaring in either the upwards or downwards direction, or a combination of outward and upward flaring cones.

[0027] Turning now particularly to FIGS. 4 and 5, the noise absorbing section 104 is illustrated as further having an outer ring 106, which has a straight C-shaped cross section and may be formed by a rolled steel cylinder having a straight sided outer wall 108 and top and bottom walls 110 and 112. The

arrangement also features a thickness of sound absorbing material **114**, which in one preferred embodiment may be fiberglass batting. As discussed herein, the sound absorbing material **114** may be other materials such as foam or a material having a complex reflective or absorbing surface finish. Also, combinations of various sound absorbing materials may be used to make up the sound absorbing material **114**.

[0028] In the illustrated embodiment, an inner screen **120** is provided inside of the location of the sound absorbing material **114**. The screen **120** is at least somewhat permeable to sound so that the sound will be absorbed by the sound absorbing material **114**, and further can provide structural support to retain the sound absorbing material **114** in place. In this embodiment, a steel screen is used having 20 to 50 per cent open area. Examples of suitable screens include metal or plastic plate perforated with holes or slots, or metal or plastic mesh. In the case of a sound absorbing material **114** that loses its integrity when subjected to airflow, vibration and/or moisture, the screen **120** serves the function of retaining the sound absorbing material **114** in its place, so that it does not tend to shred or come apart. The screen **120** also reduces the moisture that will enter the sound absorbing material **114** in the case of, for example, rain falling into the fan shroud. Additionally, a water resistant membrane may be placed between screen **120** and sound absorbing material **114**. A water resistant membrane example is Gore-Tex® material. In the embodiment as depicted in FIGS. 3-5, the overall fan shroud **26**, including the sound absorbing material features, is supported from above by a fan deck **16** by using conventional support arrangement.

[0029] FIG. 6 shows the outer ring **106** in combination with the screen **120** forming a hollow pocket **122**. In FIG. 6 the sound-absorbing material **114** is not shown. FIG. 6 also shows that the outer ring **106** can be made of a number of rolled boxed curved steel segments, which can be joined by virtue of flanges **124** that accept bolts into neighboring flanges of the neighboring arcuate sections. FIG. 6 also illustrates a flange **126** provided along the bottom of the ring **106**, which can facilitate joining with the flared inlet portion **102**.

[0030] FIGS. 7 and 8 illustrate a second embodiment which utilizes the principles of the first embodiment described above, but adds some variations and additional features. For example, in the embodiment of FIG. 7, a flared inlet section **202** is integral with the outer ring of the noise absorbing section **204**. Thus, an entire shroud is formed by a plurality of arcuate sections with each section having a lower flared portion **204** and an upper outer ring of a sound absorbing portion **204**. In the example of FIG. 7, the entire shroud is made of a plurality of arcuate sections. In this example, each arcuate section has been molded from fiberglass material. Joining flanges **224** are provided, and can be bolted to each other. In the case of fiberglass construction, intermediate steel plates re-enforcements may be bolted to be sandwiched in between the neighboring flanges **224**.

[0031] Turning further to the sound absorbing portions **204** in the embodiment of FIGS. 7 and 8, it will be appreciated that each section forms part of the sound absorbing portion **204** and has one or more pockets **222** that are molded directly into the structure. In the example of FIGS. 7 and 8, two elongated pockets **222** are molded one above the other. This provides an intermediate rib structure **223** between the pockets **222** which can enhance the stiffness of the sections.

[0032] As with the previous embodiment discussed above, a screen **220** is provided forming part of the inner surface of the fan shroud. Disposed between the screen **220** and the

pockets **222** are sound absorbing material **214**. As illustrated in FIG. 7, the sound absorbing material **214** includes segments of fiberglass batting **208**. The fiberglass batting **208** tends to absorb sound. Although fiberglass batting is discussed with respect to the second embodiment, any other sound absorbing material or a combination of materials may be employed. In the embodiment of FIGS. 7 and 8, the screen may be attached by screws **232** screwed into the ring structure **204**.

[0033] The above-described examples show structures that can reduce the sound emitted by a fan deck in an ACC. Aspects of these embodiments can also be applied to other heat exchange tower fans.

[0034] The many features and advantages of the invention are apparent from the detailed specification, and thus, it is intended by the appended claims to cover all such features and advantages of the invention which fall within the true spirit and scope of the invention. Further, since numerous modifications and variations will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed is:

1. A heat exchange tower, comprising:
at least one fan having fan blades with outer tips rotating in a circle of rotation; and
a fan shroud, the fan shroud comprising:
an outer ring structure; and
a sound absorbing material mounted to the outer ring surface and disposed radially inside the outer ring structure and outside of the circle of rotation of the tips of the fan blades.
2. The heat exchange tower of claim 1, wherein the fan shroud comprises a flared inlet portion leading into the outer ring structure.
3. The heat exchange tower of claim 2, wherein the inlet portion is integral with the outer ring structure.
4. The heat exchange tower according to claim 1, further comprising an inner structure that sandwiches the sound absorbing material between the inner structure and the outer ring structure.
5. The heat exchange tower according to claim 4, wherein the inner structure comprises a metal screen.
6. The heat exchange tower according to claim 1, wherein the outer ring comprises a plurality of arcuate sections.
7. The heat exchange tower according to claim 1, wherein the outer ring comprises at least one C-shaped arcuate metal band.
8. The heat exchange tower according to claim 1, wherein the outer ring comprises at least one molded fiberglass arcuate section that forms at least one pocket that receives the sound absorbing material.
9. The heat exchange tower according to claim 1, wherein the sound absorbing material is fiberglass batting.
10. The heat exchange tower according to claim 1, wherein the sound absorbing material is foam.
11. The heat exchange tower according to claim 4, wherein the outer ring comprises at least one C-shaped arcuate metal band.
12. The heat exchange tower according to claim 4, wherein the outer ring comprises at least one molded fiberglass arcuate section that forms at least one pocket that receives the sound absorbing material.

13. The heat exchange tower according to claim **4**, wherein the sound absorbing material is fiberglass batting.

14. The heat exchange tower according to claim **4**, wherein the sound absorbing material is foam.

15. A heat exchange tower, comprising:

at least one fan having fan blades with outer tips rotating in a circle of rotation; and

a fan shroud, the fan shroud comprising:

an outer supporting means; and

a sound absorbing means mounted to the outer supporting means disposed radially inside the outer supporting means and outside of the circle of rotation of the tips of the fan blades.

16. The heat exchange tower of claim **15**, wherein the fan shroud comprises a flared inlet portion leading into the outer supporting means.

17. The heat exchange tower according to claim **15**, further comprising an inner supporting means that sandwiches the sound absorbing material between the inner and the outer supporting means.

18. A heat exchange tower, comprising:

at least one fan having fan blades with outer tips rotating in a circle of rotation; and

a fan shroud, the fan shroud comprising:

an outer ring structure formed of at least one molded section, the section forming at least one pocket; and

a sound absorbing material disposed inside the pocket and radially outside of the circle of rotation of the tips of the fan blades.

19. A heat exchange tower according to claim **18**, wherein the molded section includes at least two axially spaced pockets separated by a rib in between the pockets, with sound absorbing material disposed in each pocket.

20. A method for reducing sound emitted by a heat exchange tower, the tower having at least one fan blade with outer tips rotating in a circle of rotation, and a fan shroud surrounding the circle of rotation of the tips, comprising the step of:

providing a sound absorbing material on an inner surface of the shroud between the inner surface of the shroud and the circle of rotation of the blade tips.

21. An air cooled condenser, comprising:

a plurality of condenser coils;

a fan deck disposed below the condenser coils, the fan deck comprising a plurality of fans having fan blades with outer tips rotating in a circle of rotation, and a plurality of fan shrouds each surrounding a respective fan, each fan shroud comprising:

an outer ring structure; and

a sound absorbing material mounted to the outer ring surface and disposed radially inside the outer ring structure and outside of the circle of rotation of the tips of the fan blades.

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