A column air handling system includes a coil unit having a set of coils for changing a temperature of an air stream flowing therethrough and a fan unit for driving the air stream through the coil unit. The fan unit includes a plenum fan directly driven by a motor.
REduced NOISE AIR CONDITIONING AND HEATING SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATION


FIELD OF INVENTION

[0002] The present invention relates in general to air conditioning and heating techniques, and in particular to reduced noise air conditioning and heating systems.

BACKGROUND OF INVENTION

[0003] Air conditioning and heating systems, including column air handling units, are known in the art. However, existing column air handling units are subject to a number of significant disadvantages.

[0004] For example, the column air handling units disclosed in U.S. Pat. No. 6,402,612 and U.S. Pat. No. 6,267,665 utilize vane-axial fans, which operate at high speed and high pressure and hence generate a substantial amount of noise, which force the use of inlet and outlet silencers, such as cones, to make the generated noise level acceptable. Additionally, these systems utilize a high pressure design known as static regain that requires a series of hand manufactured tunnels and cones to enhance fan performance, which make the systems unnecessarily large and more expensive. Furthermore, the primary coils are provided on two opposing sides of the system, thereby requiring a larger space for installation. Finally, the fan is elevated high in the system which requires extensive field labor during installation, particularly if the fan is shipped unassembled.

[0005] Due to these significant disadvantages of the prior art, among others, improved column air, air conditioning and heating systems are needed, which are quiet, compact, and easy to install.

SUMMARY OF INVENTION

[0006] According to one embodiment of the principles of the present invention, a column air handling system is disclosed that includes a coil unit including a set of coils for changing a temperature of an air stream flowing therethrough and a fan unit for driving the air stream through the coil unit. The fan unit includes a plenum fan directly driven by a motor.

[0007] The use of a plenum fan and direct drive motor advantageously reduces the amount of noise generated by the column air handling system; particularly in view of prior art vane-axial fan systems.

[0008] Additional embodiments of the principles of the present invention include a fan assembly, which includes the plenum fan and the direct drive motor and which is extendable from a given side of the fan unit. Preferably, the extendable fan unit is disposed low in the column unit (e.g. just above a base unit that allows the column air handling system to discharge air under a raised floor), such that the plenum fan and direct drive motor are easily accessible for replacement or servicing.

BRIEF DESCRIPTION OF DRAWINGS

[0009] For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

[0010] FIG. 1 is a diagram of a representative column air conditioning/heating unit embodying the principles of the present invention;

[0011] FIGS. 2A-2E are a series of more detailed diagrams of the column air conditioning/heating unit of FIG. 1; and

[0012] FIGS. 3A-3E are a series of more detailed diagrams of the quick release connector shown in FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

[0013] The principles of the present invention and their advantages are best understood by referring to the illustrated embodiment depicted in FIGS. 1-3 of the drawings, in which like numbers designate like parts.

[0014] FIG. 1 is a diagram illustrating a typical application of a column air conditioning/heating unit 100 embodying the principles of the present invention. As shown in FIG. 1, air conditioning/heating unit 100 is vertically disposed between concrete slabs 101a-101b, which are, for example, floors of a multiple floor building. Air conditioning/heating unit 100 is disposed in a space between a pair of horizontally spaced walls 102a and 102b.

[0015] A representative room is defined by wall 102a, a raised floor 103, and an internal ceiling 104. Outside air is provided to conditioning/heating unit 100 from a pre-treatment unit outside the room through a conduit 105 disposed in the space between concrete slab 101a and internal ceiling 104.

[0016] As shown in FIG. 1, primary coils 108a and 108b are located on adjacent sides of air conditioning/heating unit 100, which allows air conditioning/heating unit 100 to be installed into a corner and those require less floor space. (In FIG. 1, filters 206 have been removed to expose coils 108a-108b, which are shown on the front and left sides of conditioning/heating unit 100). Primary coils 108a-108b may circulate chilled water, synthetic coolant (e.g. Freon), hot water, or steam. A bypass damper 109, on the right side of air conditioning/heating unit 100, allows return air to bypass coils 108a and 108b. (Bypass damper 109 is associated with an additional filter on the right side of air conditioning/heating unit 100). In alternate embodiments, coils 108a-108b may be stacked on a single side of air conditioning/heating unit 100.

[0017] During cooling operation, air conditioning/heating unit 100 pulls return air flow through the space between floor 101a and internal ceiling 104. Some of the return air, typically at approximately 75 degrees Fahrenheit, passes across coils 108a-108b, and is cooled to typically about 50 degrees Fahrenheit. The rest of the return air flows directly through bypass damper 109 without additional cooling. The cooled air flowing across coils 108a-108b and the air flowing through bypass damper 109, is mixed with the outside air provided through conduit 105, which typically has been cooled to approximately 55 degrees Fahrenheit. The resulting discharge air is typically at approximately 60 to 65 degrees Fahrenheit.
[0018] Air conditioning/heating unit 100 then discharges the cooled and filtered air into the space between concrete slab 101b and raised floor 103. The discharge air flow passes through raised floor 103 through a set of air diffusers 106. Pressure monitors 107 monitors the discharge air pressure within the space between raised floor 103 and concrete slab 101a.

[0019] Figs. 2A-2D are a series of more detailed views of air conditioning/heating unit 100. As shown in Figs. 2A and 2B, the primary components of air conditioning/heating unit 100 include elbow section 200, which receives outside air from conduit 105 of Fig. 1. Coil and filter section 201 includes the filters for filtering return air flow intake, as well as coils 108a and 108b for cooling or heating that air. Variable frequency drive section 202 passes air pulled by fan section 203, and supports electronic controls for varying the motor speed and for disconnecting air conditioning/heating unit 100, when required.

[0020] In the illustrated embodiment, coils and filter section 201, variable frequency drive section 202, and fan unit 203 have a rectangular construction, which generally includes a metallic frame and metal sidewalls, along with apertures as required for supporting structures such as the filters, elbow 200, and access doors. Depending on the application, number, sizes, and shapes of the units making up air conditioning/heating unit 100 may vary.

[0021] Independent support section 205 maintains air cooling unit 100 above the associated supporting structure (e.g., concrete slab 101 in Fig. 1) and includes a pyramid-shaped deflector 223 that discharges air outward from fan assembly 204 in all directions. Support section 205 varies in height from embodiment to embodiment, depending on the exact height of floor 103, and may range in height, for example, from 8" to 48". Advantageously, independent support section 205 allows for access flooring and flashing to be installed between the installation of the remainder of air conditioning/heating unit 100. This feature significantly reduces the amount of field labor required during the installation of air conditioning/heating unit 100.

[0022] As shown in Fig. 2C, coil and filter section 201 includes a set of service filters 206 for filtering return air. In some embodiments, coil and filter section 201 may include electrical heating elements. In the illustrated embodiment, primary coils are selected to operate at an approximate flow rate 300 FPM (feet per minute) to minimize moisture delivery in the discharge air flow.

[0023] A pair of connectors 207 allows the cooling or heating fluid to be cycled through the internal cooling coils. Drain pan connection 208 provides for the removal of condensate extracted from the return air by the coils.

[0024] Variable frequency drive section 202 includes drive motor control 209 and a lockable disconnect control switch 210. Drive motor controls 209 allows the speed of the direct drive motor of fan unit 201, discussed in detail below. In the overall system shown in Fig. 1, drive controls 209 receive electronic feedback from pressure sensors 107 and adjust the motor speed as appropriate to main the appropriate air pressure in the space between concrete slab 107 and raised floor 103.

[0025] The frame of fan unit 203 includes tracks which support fan assembly 204. Advantageously, fan assembly 204 is located just above the floor and rolls into and out on casters on the front and rear edges of the top of the assembly frame, as discussed further below in conjunction with Fig. 2E. In Fig. 2C, fan assembly 204 is shown on a dolly 213, which allows it to be rolled to fan unit 203 and the casters engaged with the corresponding tracks. Preferably dolly 213 includes a manual hydraulic lifting device that allows fan assembly 204 to be easily mated with the support structure of fan unit 203. (Fan assembly 204 can be completely or partially rolled-out on track extensions, as needed for installation, replacement, or servicing.)

[0026] Fan assembly 204 includes a quite plenum fan with direct drive motor assembly 212 and fan dolly 213. Removable doors 214 provide access to fan assembly 204, within metal casing 215. Removable doors 214 also allow access to the drain pan within coil and filter section 201 for cleaning purposes. A quick release flexible connector 110, shown in Fig. 1, allows fan assembly 204 to be released from the frame of fan unit 203.

[0027] Figs. 2D-2E illustrate fan assembly 204 in further detail. In particular, fan assembly 204 includes a direct drive motor 216 and fan 217. Direct drive motor 216 is supported by motor frame 216. Rolling frame 211 is generally formed by tubular members 219 and includes casters 220 and isolators 221. The fan plenum extends through an apron 222.

[0028] In the illustrated embodiment, direct drive motor 216 is a nominally rated 900 RPM, (rotations per minute) 10 HP (horsepower) motor operating from a three-phase, 460 volt, 60 Hz power source. In alternate embodiments, drive motor 216 may have a higher rated speed, for example 1200 RPM, although preferably the rated speed is kept below the typical rated 1700 RPM speed used in conventional high pressure/high velocity vane-axial systems, to reduce noise and vibration. During typical operation of the illustrated embodiment (i.e. with a 900 RPM motor) motor controls 209 maintain the speed of motor 216 within the approximate range of 400 to 700 RPM.

[0029] Advantageously, quite plenum fan 217 does not require inlet or outlet air plenums or an inlet cone. The size of quite plenum fan 217 will vary depending on the application of air handling system 100 and may provide, for example, flow rates of between 1000 to 25,000 CFM (cubic feet per minute).

[0030] Figs. 3A-3E are a series of view of quick release connector 110 shown in Fig. 1, with Fig. 3A showing an alternate configuration of air conditioning/heating unit 100. Advantageously, quick release connector 110 allows fan assembly 204 to be quickly and easily released from fan unit 203.

[0031] As shown in Fig. 3B, quick release connector 110 wraps around the upper edge 310 of plenum fan 217. Spring steel strips 311 are sewn along the upper and lower edges of the flexible material of quick release connector 110. One end of quick connect connector 110 includes a small section 312 of female industrial Velcro and the opposing end includes a small corresponding section 313 of male industrial Velcro. As shown in Figs. 3C and 3E, a pair of quick release latches 314 is also provided.

[0032] During use, as shown in Fig. 3E, spring steel strips 311, 312, and 313, and quick release latches 314 ensure that quick release connector 110 maintains a snug fit around edge 310 of plenum fan 217. Advantageously, the leakage of heated or cooled air being pulled by fan unit 213 is minimized.

[0033] Although the invention has been described with reference to specific embodiments, these descriptions are not meant to be construed in a limiting sense. Various modifica-
tions of the disclosed embodiments, as well as alternative embodiments of the invention, will become apparent to persons skilled in the art upon reference to the description of the invention. It should be appreciated by those skilled in the art that the conception and the specific embodiment disclosed might be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims.

[0034] It is therefore contemplated that the claims will cover any such modifications or embodiments that fall within the true scope of the invention.

What is claimed is:

1. A column air handling system:
a coil unit including a set of coils for changing a temperature of an air stream flowing therethrough; and
a fan unit for pulling the air stream through the coil unit, the
fan unit including a plenum fan directly driven by a motor.

2. The column air handling system of claim 1, wherein the fan unit comprises a fan unit frame and the plenum fan and motor form a portion of an assembly adapted to roll within the fan unit frame.

3. The column air handling system of claim 1, wherein the coil unit includes a set of coils for receiving a flow of fluid for cooling the air stream flowing through the coil unit.

4. The column air handling system of claim 1, wherein the coil unit includes a set of coils for receiving a flow of fluid for heating the air stream flowing through the coil unit.

5. The column air handling system of claim 1, wherein the coil unit further comprises a bypass damper for passing untreated air flow into the coil unit for mixing with treated air.

6. The column air handling system of claim 1, further comprising an independent base unit for supporting the fan and coil units, the independent base unit including a diffuser for directing the air stream away from the column air handling system.

7. The column air handling system of claim 1, wherein the coil unit further comprises electric heating devices for heating air flowing therethrough.

8. An air handling system comprising:
a coil and filter unit for treating air; and
a fan unit for moving air through the coil and filter unit and
including a plenum fan directly driven by a motor.

9. The air handling system of claim 8, wherein the coil and filter unit and the fan unit form portions of a column structure.

10. The air handling system of claim 9, wherein the coil and filter unit includes a bypass damper for receiving untreated return air.

11. The air handling system of claim 9, wherein the coil and filter unit includes a port for receiving pre-treated air.

12. The air handling system of claim 9, wherein the fan unit includes a fan assembly including the plenum fan and the motor and the fan assembly is extendable from a side of the fan unit.

13. The air handling system of claim 12, wherein the fan assembly includes rollers for extending the fan assembly from the fan unit.

14. The air handling system of claim 12, further comprising a quick release connector for connecting the fan unit and the fan assembly, the quick release connector comprising a strip of flexible material containing at least one strip of spring steel and at least one connecting mechanism for connecting opposing ends of the strip of flexible material during use.

15. The air handling system of claim 9, wherein the coil and filter unit includes coils selected from the group of chilled water, steam, synthetic coolant, and heated water coils.

16. The air handling system of claim 9, further comprising an independent base unit for supporting the coil and filter unit and the fan unit, a height of the base unit selected for discharging air flow moving through the coil and filter unit to a space under a raised floor.

17. A column air handling system comprising:
a base unit adapted to direct discharge air to a space under a raised floor;
a fan unit adapted for seating on the base unit and including a fan assembly having a plenum fan and a motor for directly driving the plenum fan, wherein the fan assembly is extendable from a side of the fan unit; and
a coil and filter unit adapted for seating above the fan unit.

18. The column air handling system of claim 17, further comprise a variable frequency drive unit for controlling the speed of the motor and adapted for seating between the fan unit and the coil and filter unit.

19. The column air handling system of claim 17, wherein the coil and filter unit is selectively adapted to cool and heat air moving therethrough as driven by the fan unit.

20. The column air handling system of claim 17, further comprising a quick release connector for connecting the fan unit and the fan assembly, the quick release connector comprising a strip of flexible material containing at least one strip of spring steel and at least one connecting mechanism for connecting opposing ends of the strip of flexible material during use.

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