A microchannel heat exchanger of an HVAC system may include a plurality of microchannel tubes having fins disposed between at least one pair of adjacent microchannel tubes. The pair of adjacent microchannel tubes may connect a header on each end of the microchannel tubes in fluid communication, and at least one of the microchannel tubes and the fins are oriented substantially parallel with respect to a primary airflow direction of an airflow across the microchannel heat exchanger.
MICROCHANNEL HEAT EXCHANGER
CROSS-REFERENCE TO RELATED APPLICATIONS


STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

REFERENCE TO A MICROFICHE APPENDIX

[0003] Not applicable.

BACKGROUND

[0004] Heating, ventilation, and/or air conditioning (HVAC) systems may generally be used in residential and/or commercial structures to provide heating and/or cooling to climate-controlled areas within these structures. Some HVAC systems may comprise a microchannel heat exchanger. Some microchannel heat exchangers may comprise a plurality of microchannel tubes and/or fins that are oriented at an angle relative to a primary direction of airflow across the tubes and/or fins. In some cases, the angled orientation may cause an undesirable pressure drop across the microchannel heat exchanger.

SUMMARY

[0005] In some embodiments of the disclosure, a microchannel heat exchanger is disclosed as comprising a plurality of microchannel tubes and fins disposed between at least one pair of adjacent microchannel tubes, wherein at least one of a microchannel tube and a fin is oriented substantially parallel to a primary airflow direction of the microchannel heat exchanger.

[0006] In other embodiments of the disclosure, an air handling unit is disclosed as comprising a primary airflow direction and a microchannel heat exchanger comprising a plurality of microchannel tubes and fins disposed between at least one pair of adjacent microchannel tubes, wherein at least one of a microchannel tube and a fin is oriented substantially parallel to the primary airflow direction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] For a more complete understanding of the present disclosure and the advantages thereof, reference is now made to the following brief description, taken in connection with the accompanying drawings and detailed description, wherein like reference numerals represent like parts.

[0008] FIG. 1 is a schematic diagram of an HVAC system according to an embodiment of the disclosure;
[0009] FIG. 2 is a schematic front view of the indoor unit of FIG. 1 comprising a microchannel heat exchanger according to an embodiment of the disclosure;
[0010] FIG. 3 is a top view of the microchannel heat exchanger of FIG. 2;
[0011] FIG. 4 is a side view of the microchannel heat exchanger of FIG. 2;
[0012] FIG. 5 is a front view of the microchannel heat exchanger of FIG. 2 with the headers removed;
[0013] FIG. 6 is a partial cutaway oblique view of a plurality of microchannel tubes of the outdoor heat exchanger according to an embodiment of the disclosure;
[0014] FIG. 7 is a top view of a microchannel heat exchanger according to an alternative embodiment of the disclosure; and
[0015] FIG. 8 is a front view of the microchannel heat exchanger of FIG. 7.

DETAILED DESCRIPTION

[0016] In some cases, it may be desirable to provide a microchannel heat exchanger in a heating, ventilation, and/or air-conditioning (HVAC) system. Some microchannel heat exchangers may comprise microchannel tubes and/or fins that may be oriented relative to a primary direction of airflow in a manner that unnecessarily requires more energy to be consumed to move air through the microchannel heat exchanger. Some systems and methods of this disclosure may provide microchannel heat exchangers and/or air handling units comprising microchannel heat exchangers in which the microchannel tubes and/or fins of the microchannel heat exchangers are oriented relative to a primary direction of airflow in a manner selected to minimize a pressure drop across the microchannel heat exchanger. This disclosure further contemplates microchannel heat exchangers and/or air handling units comprising microchannel heat exchangers in which the microchannel tubes and/or fins of the microchannel heat exchangers are oriented substantially parallel relative to a primary direction of airflow to minimize a pressure drop across the microchannel heat exchanger. In some embodiments, the charge tolerant microchannel heat exchanger may be used in an indoor unit and/or an outdoor unit of an HVAC system, including, but not limited to, a heat pump system.

[0017] Referring now to FIG. 1, a schematic diagram of an HVAC system 100 is shown according to an embodiment of the disclosure. HVAC system 100 generally comprises an indoor unit 102, an outdoor unit 104, and a system controller 106. The system controller 106 may generally control operation of the indoor unit 102 and/or the outdoor unit 104. As shown, the HVAC system 100 is a so-called heat pump system that may be selectively operated to implement one or more substantially closed thermodynamic refrigeration cycles to provide a cooling functionality and/or a heating functionality.

[0018] Indoor unit 102 generally comprises an indoor heat exchanger 108, an indoor fan 110, and an indoor metering device 112. Indoor heat exchanger 108 is a plate fin heat exchanger configured to allow heat exchange between refrigerant carried within internal tubing of the indoor heat exchanger 108 and fluids that contact the indoor heat exchanger 108 but that are kept segregated from the refrigerant. In other embodiments, indoor heat exchanger 108 may comprise a spine fin heat exchanger, a microchannel heat exchanger, or any other suitable type of heat exchanger.

[0019] The indoor fan 110 is a centrifugal blower comprising a blower housing, a blower impeller at least partially disposed within the blower housing, and a blower motor configured to selectively rotate the blower impeller. In other embodiments, the indoor fan 110 may comprise a mixed-flow fan and/or any other suitable type of fan. The indoor fan 110 is configured as a modulating and/or variable speed fan capable of being operated at many speeds over one or more ranges of speeds. In other embodiments, the indoor fan 110...
may be configured as a multiple speed fan capable of being operated at a plurality of operating speeds by selectively electrically powering different ones of multiple electromagnetic windings of a motor of the indoor fan 110. In yet other embodiments, the indoor fan 110 may be a single speed fan.

[0020] The indoor metering device 112 is an electronically controlled motor driven electronic expansion valve (EEV). In alternative embodiments, the indoor metering device 112 may comprise a thermostatic expansion valve, a capillary tube assembly, and/or any other suitable metering device. The indoor metering device 112 may comprise and/or be associated with a refrigerant check valve and/or refrigerant bypass for use when a direction of refrigerant flow through the indoor metering device 112 is not intended to meter or otherwise substantially restrict flow of the refrigerant through the indoor metering device 112.

[0021] Outdoor unit 104 generally comprises an outdoor heat exchanger 114, a compressor 116, an outdoor fan 118, an outdoor metering device 120, and a reversing valve 122. Outdoor heat exchanger 114 is a microchannel heat exchanger configured to allow heat exchange between refrigerant carried within internal passages of the outdoor heat exchanger 114 and fluids that contact the outdoor heat exchanger 114 but that are kept segregated from the refrigerant. In other embodiments, outdoor heat exchanger 114 may comprise a plate fin heat exchanger, a spine fin heat exchanger, or any other suitable type of heat exchanger.

[0022] The compressor 116 is a multiple speed scroll type compressor configured to selectively pump refrigerant at a plurality of mass flow rates. In alternative embodiments, the compressor 116 may comprise a modulating compressor capable of operation over one or more speed ranges, a reciprocating type compressor, a single speed compressor, and/or any other suitable refrigerant compressor and/or refrigerant pump.

[0023] The outdoor fan 118 is an axial fan comprising a fan blade assembly and fan motor configured to selectively rotate the fan blade assembly. In other embodiments, the outdoor fan 118 may comprise a mixed-flow fan, a centrifugal blower, and/or any other suitable type of fan and/or blower. The outdoor fan 118 is configured as a modulating and/or variable speed fan capable of being operated at many speeds over one or more ranges of speeds. In other embodiments, the outdoor fan 118 may be configured as a multiple speed fan capable of being operated at a plurality of operating speeds by selectively electrically powering different ones of multiple electromagnetic windings of a motor of the outdoor fan 118. In yet other embodiments, the outdoor fan 118 may be a single speed fan.

[0024] The outdoor metering device 120 is a thermostatic expansion valve. In alternative embodiments, the outdoor metering device 120 may comprise an electronically controlled motor driven EEV similar to indoor metering device 112, a capillary tube assembly, and/or any other suitable metering device. The outdoor metering device 120 may comprise and/or be associated with a refrigerant check valve and/or refrigerant bypass for use when a direction of refrigerant flow through the outdoor metering device 120 is such that the outdoor metering device 120 is not intended to meter or otherwise substantially restrict flow of the refrigerant through the outdoor metering device 120.

[0025] The reversing valve 122 is a so-called four-way reversing valve. The reversing valve 122 may be selectively controlled to alter a flow path of refrigerant in the HVAC system 100 as described in greater detail below. The reversing valve 122 may comprise an electrical solenoid or other device configured to selectively move a component of the reversing valve 122 between operational positions.

[0026] The system controller 106 may generally comprise a touchscreen interface for displaying information and for receiving user inputs. The system controller 106 may display information related to the operation of the HVAC system 100 and may receive user inputs related to operation of the HVAC system 100. However, the system controller 106 may further be operable to display information and receive user inputs tangentially and/or unrelated to operation of the HVAC system 100. In some embodiments, the system controller 106 may not comprise a display and may derive all information from inputs from remote sensors and remote configuration tools. In some embodiments, the system controller 106 may comprise a temperature sensor and may further be configured to control heating and/or cooling of zones associated with the HVAC system 100. In some embodiments, the system controller 106 may be configured as a thermostat for controlling supply of conditioned air to zones associated with the HVAC system 100.

[0027] In some embodiments, the system controller 106 may also selectively communicate with an indoor controller 124 of the indoor unit 102, with an outdoor controller 126 of the outdoor unit 104, and/or with other components of the HVAC system 100. In some embodiments, the system controller 106 may be configured for selective bidirectional communication over a communication bus 128. In some embodiments, portions of the communication bus 128 may comprise a three-wire connection suitable for communicating messages between the system controller 106 and one or more of the HVAC system 100 components configured for interfacing with the communication bus 128. Still further, the system controller 106 may be configured to selectively communicate with HVAC system 100 components and/or any other device 130 via a communication network 132. In some embodiments, the communication network 132 may comprise a telephone network, and the other device 130 may comprise a telephone. In some embodiments, the communication network 132 may comprise the Internet, and the other device 130 may comprise a smartphone and/or other Internet-enabled mobile telecommunication device. In other embodiments, the communication network 132 may also comprise a remote server.

[0028] The indoor controller 124 may be carried by the indoor unit 102 and may be configured to receive information inputs, transmit information outputs, and otherwise communicate with the system controller 106, the outdoor controller 126, and/or any other device 130 via the communication bus 128 and/or any other suitable medium of communication. In some embodiments, the indoor controller 124 may be configured to communicate with an indoor personality module 134 that may comprise information related to the identification and/or operation of the indoor unit 102. In some embodiments, the indoor controller 124 may be configured to receive information related to a speed of the indoor fan 110, transmit a control output to an electric heat relay, transmit information regarding an indoor fan 110 volumetric flow-rate, communicate with and/or otherwise affect control over an air cleaner 136, and communicate with an indoor EEV controller 138. In some embodiments, the indoor controller 124 may be configured to communicate with an indoor fan controller 142 and/or
otherwise affect control over operation of the indoor fan 110. In some embodiments, the indoor personality module 134 may comprise information related to the identification and/or operation of the indoor unit 102 and/or a position of the outdoor metering device 120.

[0029] In some embodiments, the indoor EEV controller 138 may be configured to receive information regarding temperatures and/or pressures of the refrigerant in the indoor unit 102. More specifically, the indoor EEV controller 138 may be configured to receive information regarding temperatures and pressures of refrigerant entering, exiting, and/or within the indoor heat exchanger 110. Further, the indoor EEV controller 138 may be configured to communicate with the indoor metering device 112 and/or otherwise affect control over the indoor metering device 112. The indoor EEV controller 138 may also be configured to communicate with the outdoor metering device 120 and/or otherwise affect control over the outdoor metering device 120.

[0030] The outdoor controller 126 may be carried by the outdoor unit 104 and may be configured to receive information inputs, transmit information outputs, and otherwise communicate with the system controller 106, the indoor controller 124, and/or any other device via the communication bus 128 and/or any other suitable medium of communication. In some embodiments, the outdoor controller 126 may be configured to communicate with an outdoor personality module 140 that may comprise information related to the identification and/or operation of the outdoor unit 104. In some embodiments, the outdoor controller 126 may be configured to receive information related to an ambient device temperature associated with the outdoor unit 104, information related to a temperature of the outdoor heat exchanger 114, and/or information related to refrigerant temperatures and/or pressures of refrigerant entering, exiting, and/or within the outdoor heat exchanger 114 and/or the compressor 116. In some embodiments, the outdoor controller 126 may be configured to transmit information related to monitoring, communicating with, and/or otherwise affecting control over the outdoor fan 118, a compressor sump heater, a solenoid of the reversing valve 122, a relay associated with adjusting and/or monitoring a refrigerant charge of the HVAC system 100, a position of the indoor metering device 112, and/or a position of the outdoor metering device 120. The outdoor controller 126 may further be configured to communicate with a compressor drive controller 144 that is configured to electrically power and/or control the compressor 116.

[0031] The HVAC system 100 is shown configured for operating in a so-called cooling mode in which heat is absorbed by refrigerant at the indoor heat exchanger 108 and heat is rejected from the refrigerant at the outdoor heat exchanger 114. In some embodiments, the compressor 116 may be configured to compress refrigerant and pump the relatively high temperature and high pressure compressed refrigerant from the compressor 116 to the outdoor heat exchanger 114 through the reversing valve 122 and to the outdoor heat exchanger 114. As the refrigerant is passed through the outdoor heat exchanger 114, the outdoor fan 118 may be operated to move air into contact with the outdoor heat exchanger 114, thereby transferring heat from the refrigerant to the air surrounding the outdoor heat exchanger 114. The refrigerant may primarily comprise liquid phase refrigerant and the refrigerant may flow from the outdoor heat exchanger 114 to the indoor metering device 112 and/or around the outdoor metering device 120 which does not substantially impede flow of the refrigerant in the cooling mode. The indoor metering device 112 may meter passage of the refrigerant through the indoor metering device 112 so that the refrigerant downstream of the indoor metering device 112 is at a lower pressure than the refrigerant upstream of the indoor metering device 112. The pressure differential across the indoor metering device 112 allows the refrigerant downstream of the indoor metering device 112 to expand and/or at least partially convert to a two-phase (vapor and gas) mixture. The two-phase refrigerant may enter the indoor heat exchanger 108. As the refrigerant is passed through the indoor heat exchanger 108, the indoor fan 110 may be operated to move air into contact with the indoor heat exchanger 108, thereby transferring heat to the refrigerant from the air surrounding the indoor heat exchanger 108, and causing evaporation of the liquid portion of the two phase mixture. The refrigerant may thereafter re-enter the compressor 116 after passing through the reversing valve 122.

[0032] To operate the HVAC system 100 in the so-called heating mode, the reversing valve 122 may be controlled to alter the flow path of the refrigerant, the indoor metering device 112 may be disabled and/or bypassed, and the outdoor metering device 120 may be enabled. In the heating mode, refrigerant may flow from the compressor 116 to the indoor heat exchanger 108 through the reversing valve 122, the refrigerant may be substantially unaffected by the indoor metering device 112, and the refrigerant may experience a pressure differential across the outdoor metering device 120. The refrigerant may pass through the outdoor heat exchanger 114, and the refrigerant may re-enter the compressor 116 after passing through the reversing valve 122. Most generally, operation of the HVAC system 100 in the heating mode reverses the roles of the indoor heat exchanger 108 and the outdoor heat exchanger 114 as compared to their operation in the cooling mode.

[0033] Referring now to FIG. 2, a schematic front view of the indoor unit 102 of FIG. 1 comprising a microchannel heat exchanger 108 is shown according to an embodiment of the disclosure. The indoor unit 102 generally comprises a blower cabinet 202 comprising a blower assembly 210 and a heat exchanger cabinet 206 comprising a microchannel heat exchanger 108. In some embodiments, the indoor unit 102 may also comprise a heater cabinet 220 comprising a heater assembly 222. In some embodiments, however, the heater assembly 222 may be disposed within the heat exchanger cabinet 206. The indoor unit 102 may generally comprise a blow-through type air handling unit comprising the microchannel heat exchanger 108 configured in an A-coil arrangement. However, in alternative embodiments, the indoor unit 102 may be a pull-through type air handling unit in which air is pulled through the microchannel heat exchanger 108 by a blower assembly, such as blower assembly 110, that is located downstream relative to the microchannel heat exchanger 108. Further, the microchannel heat exchanger 108 may alternatively be oriented in a V-coil arrangement. In this embodiment, the blower assembly 204 generally forces air through the indoor unit 102 and the microchannel heat exchanger 108 in a primary airflow direction 210.

[0034] Referring now to FIGS. 3-5, top, side, and front views of the microchannel heat exchanger 108 are shown, respectively. The microchannel heat exchanger 108 generally comprises a plurality of tubular headers 212 (not shown in FIG. 5) between which microchannel tubes 214 may extend horizontally to join opposing tubular headers 212 in fluid
communication with each other via a plurality of microchannels (shown as 224 and in Fig. 6) within each of the microchannel tubes 214. The microchannel tubes 214 may generally comprise a flat ribbon shape, and corrugated fins 216 may be joined between adjacent microchannel tubes 214. In operation, air may be forced between adjacent microchannel tubes 214 and into contact with fins 216 to promote heat exchange between the air moved by the blower assembly 110 and the refrigerant flowing through the microchannels of the microchannel tubes 214.

[0035] As viewed from above in Fig. 3, it can be seen that each of the microchannel tubes 214 and associated fins 216 are generally oriented parallel relative to the primary airflow direction 210. More specifically, the flat surfaces of the microchannel tubes 214 may generally be substantially parallel with respect to the primary airflow direction 210. As a result, the pressure drop across the microchannel heat exchanger 108 is minimized. Furthermore, the indoor unit 102 may operate more efficiently at least because less energy is required to move air through the microchannel heat exchanger 108. Still further, as a result of the orientation of the microchannel tubes 214 and/or fins 216 relative to the primary airflow direction 210, condensation formed on the microchannel heat exchanger 108 may be less likely to separate from the microchannel heat exchanger 108 and become entrained in the airflow, thereby exiting the microchannel heat exchanger 108. In some cases, the above-described orientation of the microchannel tubes 214 and fins 216 may be described as oriented to provide a minimum footprint area when viewed along a direction parallel to the primary airflow direction 210 and transverse to a direction of refrigerant flow through the microchannel tubes 214.

[0036] As viewed from the side in Fig. 4, it can be seen that a lowest microchannel tube 214 is oriented generally to provide, in this case, a maximum footprint area when viewed from the side. As viewed from the front in Fig. 5, it can be seen that the above-described orientation of the microchannel tubes 214 and fins 216 may be described as oriented to provide a minimum footprint area when viewed along a direction transverse to the primary airflow direction 210 and parallel to a direction of refrigerant flow through the microchannel tubes 214. It can also be seen that a significant gap 218 exist between the top located microchannel tubes 214. In some cases, while the gap 218 may reduce a pressure drop across the microchannel heat exchanger 108, because less air may be forced through the microchannel heat exchanger 108 an overall efficiency in transferring heat between the microchannel heat exchanger 108 and the air may be reduced relative to a substantially similar microchannel heat exchanger 108 comprising no gap 218.

[0037] Referring now to Fig. 6, a partial cutaway oblique view of a microchannel tube 214 of the microchannel heat exchanger 108 is shown according to an embodiment of the disclosure. In some embodiments, each microchannel tube 214 may comprise a plurality of substantially parallel microchannels 224. The microchannels 224 may generally connect the opposing tubular headers 212 in fluid communication. In some embodiments, the microchannel tubes 214 may comprise microchannels 224 that comprise substantially similar diameters. In some embodiments, the microchannel tubes 214 may also comprise a substantially similar number of microchannels 224. In embodiments where the microchannel tubes 214 comprise a substantially similar number of microchannels 224 having substantially similar diameters, it will be appreciated that each microchannel tube 214 may comprise substantially similar microchannel 224 volumes in each microchannel tube 214.

[0038] Referring now to Fig. 7 and 8, top and side views of a microchannel heat exchanger 300 are shown, respectively according to an alternative embodiment of the disclosure. The microchannel heat exchanger 300 may be substantially similar to the microchannel heat exchanger 108 insofar as it generally comprises a plurality of headers 302 joined together in fluid communication by microchannel tubes 304. Further, the adjacent microchannel tubes 304 may generally be joined by corrugated fins 306. However, in this embodiment, the headers 302 extend generally transverse to the primary airflow direction 310 rather than in a direction comprising both a significant directional component parallel to the primary airflow direction 310 and a significant directional component transverse to the primary airflow direction 310. In other words, the headers 302 generally extend orthogonally and/or normal relative to the primary airflow direction 310 rather than at a skewed angle as with tubular headers 212. Further, the uppermost located headers 302 are located substantially in abutment relative to each other thereby eliminating the above-described significant gap 218 present in microchannel heat exchanger 108. It will be appreciated that the fins 216, 306 may be formed by corrugating a sheet of fin material and thereafter cutting strips at the suitable angles to yield the arrangements shown in Figs. 3 and 7, respectively.

[0039] This disclosure contemplates a variety of alternative embodiments of microchannel heat exchangers (i.e. alternative configurations such as single slab, W-shaped, etc.) in which at least one of the microchannel tubes and the associated fins are oriented to minimize resistance to an airflow therethrough. In some embodiments, a microchannel heat exchanger 108, 300 may be provided in an indoor unit that forces air in more than one primary airflow direction. In such cases, to the extent that predefined portions of the microchannel heat exchanger are to receive airflow in different airflow directions, the microchannel tubes and/or fins of the microchannel heat exchanger may be oriented to accommodate the regional and/or localized primary airflow direction so that, as a whole, an airstream pressure drop across the microchannel heat exchanger may be minimized. Further, while the microchannel heat exchangers 108, 300 may be used in the indoor unit 102, in some embodiments, each of the microchannel heat exchangers 108, 300 may also be configured for use in the outdoor unit 104 of HVAC system 100. In some embodiments, microchannel heat exchanger 108 and/or microchannel heat exchanger 300 may be substituted for heat exchanger 114 in the outdoor unit 104 of HVAC system 100.

[0040] At least one embodiment is disclosed and variations, combinations, and/or modifications of the embodiment(s) and/or features of the embodiment(s) made by a person having ordinary skill in the art are within the scope of the disclosure. Alternative embodiments that result from combining, integrating, and/or omitting features of the embodiment(s) are also within the scope of the disclosure. Where numerical ranges or limitations are expressly stated, such express ranges or limitations should be understood to include iterative ranges or limitations of like magnitude falling within the expressly stated ranges or limitations (e.g., from about 1 to about 10 includes, 2, 3, 4, etc.; greater than 0.10 includes 0.11, 0.12, 0.13, etc.). For example, whenever a numerical range with a lower limit, RL, and an upper limit, RU, is disclosed, any number falling within the range is specifically disclosed.
particular, the following numbers within the range are specifically disclosed: R = RI + k*(RU - RI), wherein k is a variable ranging from 1 percent to 100 percent with a 1 percent increment, i.e., k is 1 percent, 2 percent, 3 percent, 4 percent, 5 percent, ... 50 percent, 51 percent, 52 percent, ..., 95 percent, 96 percent, 97 percent, 98 percent, 99 percent, or 100 percent. Moreover, any numerical range defined by two R numbers as defined in the above is also specifically disclosed. Use of the term "optionally" with respect to any element of a claim means that the element is required, or alternatively, the element is not required, both alternatives being within the scope of the claim. Use of broader terms such as comprises, includes, and having should be understood to provide support for narrower terms such as consisting of, consisting essentially of, and comprised substantially of. Accordingly, the scope of protection is not limited by the description set out above but is defined by the claims that follow, that scope including all equivalents of the subject matter of the claims. Each and every claim is incorporated as further disclosure into the specification and the claims are embodiment(s) of the present invention.

What is claimed is:

1. A microchannel heat exchanger, comprising:
   a plurality of microchannel tubes; and
   fins disposed between at least one pair of adjacent microchannel tubes;
   wherein at least one of a microchannel tube and a fin is oriented substantially parallel to a primary airflow direction of the microchannel heat exchanger.

2. The microchannel heat exchanger of claim 1 wherein at least one of the microchannel tubes is substantially flat.

3. The microchannel heat exchanger of claim 1 wherein at least one of the fins is substantially corrugated.

4. The microchannel heat exchanger of claim 1 wherein at least one of the microchannel tubes is oriented to carry refrigerant in a direction generally transverse relative to the primary airflow direction and further oriented to present a minimal footprint area when viewed in a direction parallel to the primary airflow direction while maintaining the orientation of refrigerant travel.

5. The microchannel heat exchanger of claim 1 wherein a footprint of the microchannel tubes is maximized when viewed in a direction substantially transverse relative to the primary airflow direction.

6. The microchannel heat exchanger of claim 1 wherein a footprint of the microchannel tubes is minimized when viewed in direction parallel to a direction in which the microchannel tubes carry refrigerant.

7. The microchannel heat exchanger of claim 1, further comprising headers that extend generally orthogonal relative to the primary airflow direction.

8. The microchannel heat exchanger of claim 1, further comprising a gap between two headers located furthest in the direction of the primary airflow direction.

9. The microchannel heat exchanger of claim 1 wherein no gap exists between two headers located furthest in the direction of the primary airflow direction.

10. An air handling unit, comprising:
    a primary airflow direction; and
    a microchannel heat exchanger, comprising:
    a plurality of microchannel tubes; and
    fins disposed between at least one pair of adjacent microchannel tubes;
    wherein at least one of a microchannel tube and a fin is oriented substantially parallel to the primary airflow direction.

11. The air handling unit of claim 10 wherein the air handling unit is a blow-through type air handling unit.

12. The air handling unit of claim 10 wherein the air handling unit is a pull-through type air handling unit.

13. The air handling unit of claim 10 wherein the microchannel heat exchanger is oriented as an A-coil.

14. The air handling unit of claim 10 wherein the microchannel heat exchanger is oriented as a V-coil.

15. The air handling unit of claim 10 wherein the microchannel heat exchanger further comprises a header extending generally orthogonal relative to the primary airflow direction.

16. The air handling unit of claim 10 wherein the microchannel heat exchanger further comprises a header extending generally at angle between orthogonal and parallel relative to the primary airflow direction.

17. The air handling unit of claim 10, both the microchannel tubes and the fins are oriented substantially parallel to the primary airflow direction.

18. The air handling unit of claim 10 wherein at least one of the microchannel tubes is oriented to carry refrigerant in a direction generally transverse relative to the primary airflow direction and further oriented to present a minimal footprint area when viewed in a direction parallel to the primary airflow direction while maintaining the orientation of refrigerant travel.

19. The air handling unit of claim 10 wherein a footprint of the microchannel tubes is maximized when viewed in a direction substantially transverse relative to the primary airflow direction.

20. The air handling unit of claim 10 wherein a footprint of the microchannel tubes is minimized when viewed in direction parallel to a direction in which the microchannel tubes carry refrigerant.

* * * * *