phase is recirculated through the microchannel distillation unit **400**C as a vapor phase rather than being condensed and recirculated through the microchannel distillation unit **400**A as a liquid phase. The vapor phase flows from compressor **490**, as indicated by arrows **493**, through vapor phase channel **480**, and from vapor phase channel **480** through each of the vapor phase inlet channels or tubes (**482**, **482***a*, **482***b*) into each of the microchannel distillation sections (**450**, **450***a*, **450***b*) where it combines with vapor phase flowing from the reboiler, the vapor phase flowing from the reboiler being indicated by arrows **411**, **412**, **413** and **414**. In the microchannel distillation sections (**450**, **450***a*, **450***b*) the vapor phase contacts the liquid phase flowing along the interior walls (**451**, **451***a*, **451***b*). The liquid phase and the vapor phase undergo a mass transfer in each of the distillation sections (**450**, **450***a*, **450***b*) as described above. Part of the vapor phase flows through the capture structure (**452**, **452***a*, **452***b*) and part of the vapor phase exits the microchannel distillation sections (**450**, **450***a*, **450***b*) through the vapor phase outlet channels (**484**, **484***a*, **484***b*) and flows into vapor phase channel **486**. The vapor phase flows from vapor phase channel **386** back to compressor **490** as indicated by line **494**.

[**0111**] In one embodiment, the microchannel distillation column or apparatus (e.g., column or apparatus **110** or **210**) may contain one or more microchannel distillation units having the construction of microchannel distillation unit **500** illustrated in **FIG. 18**. Referring to **FIG. 18**, microchannel distillation unit **500** comprises: liquid channel **515**; process microchannels **520**, **525**, **520***a* and **525***a*; vapor channels **535**, **540**, **545**, **535***a*, **540***a* and **545***a*; vapor inlet/outlets **550**, **552** and **554**; and heat exchange channels **570** and **575**. Liquid channel **515** contains wicking region **516**. The microchannel distillation unit **500** illustrated in **FIG. 18** comprises two microchannel distillation sections, namely, microchannel distillation sections **510** and **510***a*. It will be understood, however, that although the illustrated embodiment depicts two microchannel distillation sections, the microchannel distillation unit **500** may comprise any desired number of microchannel distillation sections, for example, three, four, five, six, seven, eight, ten, tens, hundreds, thousands, etc. Each of the microchannel distillation sections (**510**, **510***a*) comprises a first process microchannel (**520**, **520***a*), a second process microchannel (**525**, **525***a*), a first vapor channel (**535**, **535***a*), a second vapor channel (**540**, **540***a*), and a third vapor channel (**545**, **545***a*). Microchannel distillation section **510** includes vapor inlet/outlets **550** and **552**. The vapor outlet **552** also functions as a vapor inlet for microchannel distillation section **510***a*. Microchannel distillation section **510***a* includes vapor inlet/outlets **552** and **554**. The process microchannels (**520**, **525**, **520***a*, **525***a*) are adjacent to liquid channel **515**. Part of the wicking region **516** functions as a wall (**521**, **526**, **521***a*, **526***a*) for the process microchannels (**520**, **525**, **520***a*, **525***a*). While not wishing to be bound by theory, it is believed that capillary forces in the wicking region (**516**) maintain a separation between the liquid phase in the wicking region (**516**) and the vapor phase in the adjacent process microchannels (**520**, **525**, **520***a*, **525***a*), while still allowing for mass transfer to occur at the interface between the wicking region and the process microchannels. The lower interior first vapor channels (**535**, **535***a*) are adjacent to the lower process microchannels (**520**, **520***a*). The upper interior third vapor channels (**545**, **545***a*) are adjacent to the upper process microchannels (**525**, **525***a*). The outer second vapor channels (**540**, **540***a*) are adjacent to the inner first and third vapor channels (**535**, **545**, **535***a*, **545***a*). Heat exchange channel **570** is adjacent to the outer vapor channels **540** and **540***a*, and heat exchange channel **575** is adjacent to liquid channel **515**. It will be understood that if the microchannel distillation unit **500** is repeated in a microchannel distillation assembly, each repetition of the microchannel distillation unit **500** may share a heat exchange channel with the next adjacent microchannel distillation unit **500**, thus each repetition of the microchannel distillation unit **500** may have one heat exchange channel. For example, the heat exchange channel **570** of one microchannel distillation unit **500** may also function as the heat exchange channel **575** of the next adjacent microchannel distillation unit **500**. The first and third vapor channels (**535**, **545**, **535***a*, **545***a*) and the second vapor channels (**540**, **540***a*) may be positioned in different planes as illustrated in **FIG. 18**, or they may be positioned side by side in the same plane. In regions where the second vapor channel (**540**, **540***a*) and the first vapor channel (**535**, **535***a*) or third vapor channel (**545**, **545***a*) appear to cross over one another in **FIG. 18**, the flow of the vapor phase streams may be maintained in separate planes. For example, the streams shown flowing horizontally in **FIG. 18** may flow above the plane of the page, while the streams shown flowing vertically in **FIG. 18** may flow below the plane of the page. These streams may be sealed from crossing the plane of the page in such a way as to prevent vapor flow from bypassing any of the microchannel distillation sections (**510**, **510***a*). Each of the microchannel distillation sections (**510**, **510***a*) contains junctions (**523**, **528**, **523***a*, **528***a*) wherein the vapor phase contacts a wall which forms a seal with the liquid phase in the wicking region **516**. This seal in combination with capillary forces in the wicking region **516** may prevent vapor from intruding into the wicking region **516** or from bypassing any of the microchannel distillation sections (**510**, **510***a*).

[**0112**] In operation, a liquid phase containing components X and Y flows downwardly through the wicking region **516** in the liquid channel **515**, as indicated by arrows **517**. A vapor phase containing components X and Y flows through vapor inlet/out **550**, as indicated by arrow **551**, into and through first vapor channel **535** as indicated by arrow **536**, and into and through process microchannel **520**, as indicated by arrow **522**. In the process microchannel **520** the vapor phase contacts at least part of the liquid phase in the wicking region **516**. Part of the more volatile component Y transfers from the liquid phase to the vapor phase to form a component Y rich vapor phase. Part of the less volatile component X transfers from the vapor phase to the liquid phase to form a component X rich liquid phase. The vapor phase flows from process microchannel **520** to and through second vapor channel **540**, as indicated by arrows **541**, and from second vapor channel **540** into and through process microchannel **525**, as indicated by arrow **527**. In the process microchannel **525**, the vapor phase contacts at least part of the liquid phase in the wicking region **516**. Part of the more volatile component Y transfers from the liquid phase to the vapor phase to form a component Y rich vapor phase. Part of the less volatile component X transfers from the vapor phase to the liquid phase to form a component X rich liquid phase. The vapor phase flows from process microchannel **525** to and through third vapor channel **545**, as indicated by arrow **546**, and then to and through vapor inlet/outlet **552**, as indicated by arrow **553**. The vapor phase flows from vapor inlet/outlet