The present invention relates to a cascade refrigeration system which circulates a refrigerant comprising a fluoroolefin therethrough. The cascade refrigeration system includes a low temperature refrigeration loop and a medium temperature refrigeration loop. The fluoroolefin circulates through either loop, or both. In a particular embodiment, the fluoroolefin circulates through the medium temperature loop. In a particular embodiment, where the cascade refrigeration system includes a first and a second cascade heat exchanger, and a secondary heat transfer loop which extends between the first and second cascade heat exchangers, either the first and/or second refrigerant may be, but need not necessarily be, a fluoroolefin.

FIG. 1
WE CLAIM:

1. A cascade refrigeration system having at least two refrigeration
   loops, each circulating a refrigerant therethrough, comprising:

   (a) a first expansion device for reducing the pressure and
       temperature of a first refrigerant liquid;

   (b) an evaporator having an inlet and an outlet, wherein the first
       refrigerant liquid from the first expansion device enters the
       evaporator through the evaporator inlet and is evaporated in
       the evaporator to form a first refrigerant vapor, thereby
       producing cooling, and circulates to the outlet;

   (c) a first compressor having an inlet and an outlet, wherein the
       first refrigerant vapor from the evaporator circulates to the inlet
       of the first compressor and is compressed, thereby increasing
       the pressure and the temperature of the first refrigerant vapor,
       and the compressed first refrigerant vapor circulates to the
       outlet of the first compressor;

   (d) a cascade heat exchanger system having:

       (i) a first inlet and a first outlet, wherein the first refrigerant
           vapor circulates from the first inlet to the first outlet and is
           condensed in the heat exchanger system to form a first
           refrigerant liquid, thereby rejecting heat, and

       (ii) a second inlet and a second outlet, wherein a second
            refrigerant liquid circulates from the second inlet to the
            second outlet and absorbs the heat rejected by the first
            refrigerant and forms a second refrigerant vapor;

   (e) a second compressor having an inlet and an outlet, wherein
       the second refrigerant vapor from the cascade heat exchanger
       system is drawn into the compressor and is compressed,
thereby increasing the pressure and temperature of the second refrigerant vapor;

(f) a condenser having an inlet and an outlet for circulating the second refrigerant vapor therethrough and for condensing the second refrigerant vapor from the compressor to form a second refrigerant liquid, wherein the second refrigerant liquid exits the condenser through the outlet; and

(g) a second expansion device for reducing the pressure and temperature of the second refrigerant liquid exiting the condenser and entering the second inlet of the cascade heat exchanger system;

wherein at least one of the first and the second refrigerant comprises a fluorolefin.

2. The system of claim 1, wherein the second refrigerant comprises a fluorolefin selected from the group consisting of HFO-1234yf, trans-1234ze and E-1234ze.

3. The system of claim 1, wherein the second refrigerant consists essentially of HFO-1234yf.

4. The system of claim 2, wherein the second refrigerant also comprises R134a.

5. The system of claim 2, wherein the second refrigerant also comprises HFC-32.

6. The system of claim 3, wherein the first refrigerant comprises a composition selected from the group consisting of carbon dioxide and nitrous oxide.

7. The system of claim 3, wherein the first refrigerant comprises HFO-1234yf and HFC-32.
8. The system of claim 4, wherein the first refrigerant comprises a composition selected from the group consisting of carbon dioxide and nitrous oxide.

9. The system of claim 4, wherein the first refrigerant comprises HFO-1234yf and HFC-32.

10. The system of claim 5, wherein the second refrigerant comprises HFO-1234yf.

11. The system of claim 5, wherein the second refrigerant comprises trans-1234ze.

12. The system of claim 5 wherein the first refrigerant comprises carbon dioxide or nitrous oxide.

13. The system of claim 5, wherein the first refrigerant comprises HFO-1234yf and HFC-32.

14. A cascade refrigeration system having at least two refrigeration loops, each circulating a refrigerant therethrough, comprising:
   a first refrigeration loop, including:
   (a) a first expansion device for reducing the pressure and temperature of a first refrigerant liquid;
   (b) an evaporator having an inlet and an outlet, wherein the first refrigerant liquid from the first expansion device enters the evaporator through the evaporator inlet and is evaporated in the evaporator to form a first refrigerant vapor, thereby producing cooling, and circulates to the outlet;
   (c) a first compressor having an inlet and an outlet, wherein the first refrigerant vapor from the evaporator circulates to the inlet of the first compressor and is compressed, thereby increasing the pressure and the temperature of the first refrigerant vapor, and the compressed first refrigerant vapor circulates to the outlet of the first compressor;
(d) a cascade heat exchanger system comprising:

(i) a first cascade heat exchanger having:
   (A) a first inlet and a first outlet, wherein the first refrigerant vapor from the evaporator circulates from the first inlet to the first outlet and is condensed in the first heat exchanger to form a first refrigerant liquid, thereby rejecting heat, and
   (B) a second inlet and a second outlet, wherein a heat transfer fluid circulates from the second inlet to the second outlet, wherein the heat rejected by the first refrigerant vapor as it is condensed is absorbed by the heat transfer fluid,

(ii) a second cascade heat exchanger having:
   (A) a first inlet and a first outlet, wherein the heat transfer fluid from the first cascade heat exchanger circulates from the first inlet to the first outlet and rejects the heat absorbed in the first cascade heat exchanger, and
   (B) a second inlet and a second outlet, wherein a second refrigerant liquid circulates from the second inlet to the second outlet and absorbs the heat rejected by the heat transfer fluid and forms a second refrigerant vapor;

(e) a second compressor having an inlet and an outlet, wherein the second refrigerant vapor from the second cascade heat exchanger is drawn into the compressor and is compressed, thereby increasing the pressure and temperature of the second refrigerant vapor;

(f) a condenser having an inlet and an outlet for circulating the second refrigerant vapor therethrough and for condensing the second refrigerant vapor from the compressor to form a
second refrigerant liquid, wherein the second refrigerant liquid exits the condenser through the outlet; and

(g) a second expansion device for reducing the pressure and temperature of the second refrigerant liquid exiting the condenser and entering the second inlet of the second cascade heat exchanger.

15. A method of exchanging heat between at least two refrigeration loops, comprising:

(a) absorbing heat from a body to be cooled in a first refrigeration loop and rejecting this heat to a second refrigeration loop; and

(b) absorbing the heat from the first refrigeration loop in the second refrigeration loop and rejecting this heat to ambient, wherein the refrigerant in at least one of the refrigeration loops comprises a fluoroolefin.

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