Claims

1. A refrigeration system (10) comprising:

a compressor (20) having a first stage (20a) and a second stage (20b);

a heat rejecting heat exchanger (40) having a fan (44) drawing ambient fluid over the heat rejecting heat exchanger (40), the heat rejecting heat exchanger (40) including an intercooler (43) and a gas cooler (41), the intercooler (43) coupled to an outlet of the first stage (20a) and the gas cooler (41) coupled to an outlet of the second stage (20b);

a flash tank (70) coupled to an outlet of the gas cooler (41);

a primary expansion device (55) coupled to an outlet of the flash tank (70);

a heat absorbing heat exchanger (50) coupled to an outlet of the primary expansion device (55), an outlet of the heat absorbing heat exchanger (50) coupled to the suction port of the first stage (20a);

characterized in that the refrigeration system (10) further comprises:

an unload valve (93) coupled to an outlet of the intercooler (43) and a suction port of the first stage (20a); and

a controller (100) for executing a startup process including

controlling the unload valve (93) to direct refrigerant from the intercooler (43) to the suction port of the first stage (20a).

2. The refrigeration system (10) of claim 1 wherein the startup process further includes at least one of:

controlling the fan speed to reduce refrigerant heat loss in the heat rejecting heat exchanger (40);

and

controlling the primary expansion device (55) to restrict flow of refrigerant to the heat absorbing heat exchanger (50).

3. The refrigeration system (10) of claim 1 wherein the startup process includes all of:

controlling the fan speed to reduce refrigerant heat loss in the heat rejecting heat exchanger (40);

controlling the unload valve (93) to direct refrigerant from the intercooler (43) to the suction port of the first stage (20a); and

controlling the primary expansion device (55) to restrict flow of refrigerant to the heat absorbing heat exchanger (50).

4. The refrigeration system (10) of claim 1 further comprising:

an economizer valve (73) coupling the flash tank (70) to an inlet of the second stage (20b);

5. The refrigeration system (10) of claim 4 wherein:

the startup process includes controlling the economizer valve (73) to control flow of refrigerant from the flash tank (70) to the inlet of the second stage (20b).

6. The refrigeration system (10) of claim 5 wherein:

controlling the economizer valve (73) includes opening the economizer valve (73).

7. The refrigeration system (10) of claim 1 further comprising:

a motor (22) for driving the first stage (20a) and the second stage (20b);

the startup process including applying direct current to the motor (22).

8. The refrigeration system (10) of claim 1 wherein:

controlling the fan speed includes controlling fan speed in response to superheat.

9. The refrigeration system (10) of claim 8 wherein:

the fan speed is proportional to the superheat.

10. The refrigeration system (10) of claim 1 wherein:

controlling the unload valve (93) includes opening the unload valve (93).

11. The refrigeration system (10) of claim 1 wherein:

controlling the primary expansion device (55) includes controlling primary expansion device (55) in response to superheat.

12. The refrigeration system (10) of claim 1 1 wherein:

controlling the primary expansion device (55) incrementally opening the primary expansion device (55) in response to increasing superheat.

Claims

1. A refrigeration system (10) comprising:
a compressor (20) having a first stage (20a) and a second stage (20b);
a heat rejecting heat exchanger (40) having a fan (44) drawing ambient fluid over the heat rejecting heat exchanger (40), the heat rejecting heat exchanger (40) including an intercooler (43) and a gas cooler (41), the intercooler (43) coupled to an outlet of the first stage (20a) and the gas cooler (41) coupled to an outlet of the second stage (20b);

a flash tank (70) coupled to an outlet of the gas cooler (41);
a primary expansion device (55) coupled to an outlet of the flash tank (70);
a heat absorbing heat exchanger (50) coupled to an outlet of the primary expansion device (55), an outlet of the heat absorbing heat exchanger (50) coupled to the suction port of the first stage (20a);
characterized in that the refrigeration system (10) further comprises:
an unload valve (93) coupled to an outlet of the intercooler (43) and a suction port of the first stage (20a); and
a controller (100) for executing a startup process including
controlling the unload valve (93) to direct refrigerant from the intercooler (43) to the suction port of the first stage (20a) .

2. The refrigeration system (10) of claim 1 wherein the startup process further includes at least one of:
controlling the fan speed to reduce refrigerant heat loss in the heat rejecting heat exchanger (40);
and
controlling the primary expansion device (55) to restrict flow of refrigerant to the heat absorbing heat exchanger (50).

3. The refrigeration system (10) of claim 1 wherein the startup process includes all of:
controlling the fan speed to reduce refrigerant heat loss in the heat rejecting heat exchanger (40); controlling the unload valve (93) to direct refrigerant from the intercooler (43) to the suction port of the first stage (20a); and
controlling the primary expansion device (55) to restrict flow of refrigerant to the heat absorbing heat exchanger (50).

4. The refrigeration system (10) of claim 1 further comprising:
an economizer valve (73) coupling the flash tank (70) to an inlet of the second stage (20b);

5. The refrigeration system (10) of claim 4 wherein:
the startup process includes controlling the economizer valve (73) to control flow of refrigerant from the flash tank (70) to the inlet of the second stage (20b).

6. The refrigeration system (10) of claim 5 wherein:
controlling the economizer valve (73) includes opening the economizer valve (73).

7. The refrigeration system (10) of claim 1 further comprising:
a motor (22) for driving the first stage (20a) and the second stage (20b);
the startup process including applying direct current to the motor (22).

8. The refrigeration system (10) of claim 1 wherein:
controlling the fan speed includes controlling fan speed in response to superheat.

9. The refrigeration system (10) of claim 8 wherein:
the fan speed is proportional to the superheat.

10. The refrigeration system (10) of claim 1 wherein:
controlling the unload valve (93) includes opening the unload valve (93).

11. The refrigeration system (10) of claim 1 wherein:
controlling the primary expansion device (55) includes controlling primary expansion device (55) in response to superheat.

12. The refrigeration system (10) of claim 1 1 wherein:
controlling the primary expansion device (55) incrementally opening the primary expansion device (55) in response to increasing superheat.