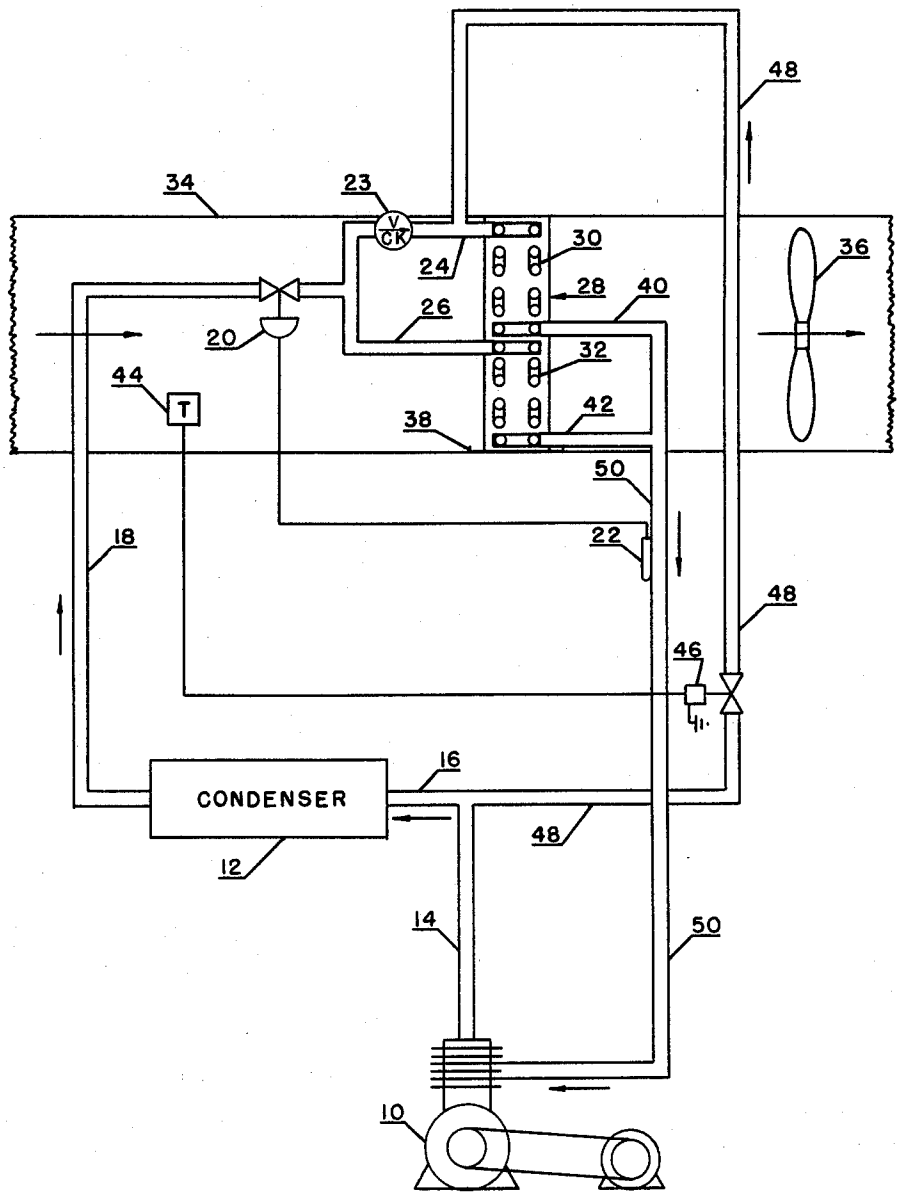
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REFRIGERATION SYSTEM CONTROL

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# REFRIGERATION SYSTEM CONTROL

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This invention relates to an air conditioning system consisting of a compressor, condenser, and an evaporator in which the cooling capacity of the evaporator is controlled to obtain comfort conditions in the area to be cooled. More particularly the system relates to the use of a hot gas by-pass to modify the heat absorbing characteristics of an evaporator coil.

Many refrigeration systems have capacity control systems which reduce the capacity of the compressor in response to a reduction of the load on the system. These systems are more expensive to manufacture and have a deleterious effect on the refrigeration system since the passage of the total air supply across the evaporator will cause an excessive rise in evaporator temperature and reduce dehumidification of the air passing over the coil thereby causing the conditioned area to be muggy even though the desired temperature is maintained. Other refrigeration systems attempt to maintain comfort conditions in the conditioned area by reducing the coil area without capacity reduction of the compressor. These systems are not practical since under reduced load conditions the coil temperature will drop and if the reduced load conditions are maintained for any length of time the evaporator coil will freeze up causing unnecessary repair and expense to the system. Therefore, I have provided my refrigeration system control to maintain comfort conditions in the conditioned area without impairing the operation of the refrigeration system.

It is an object of the invention to provide refrigeration apparatus having a compressor, a condenser, an evaporator, and a hot gas by-pass to modify the temperature of the conditioned air under reduced load conditions.

Another object of the invention is to provide an evaporator coil which has at least two circuits each of which will pass refrigerant in a path parallel to one another.

A third object of the invention is to provide a hot gas by-pass from the compressor to the evaporator coil so that upon an excessive temperature drop in the conditioned area, hot gas from the compressor will by-pass the condenser and flow to an upper circuit of the evaporator coil to modify the temperature of the air passing to the conditioned area.

Another object of the invention is to provide a refrigeration system with a hot gas by-pass which feeds the hot gas through the evaporator coil in the same direction as the expanded refrigerant.

A fifth object of the invention is to provide an evaporator coil with at least two circuits, one of which provides a path for hot by-passed refrigerant and the other to provide a path for expanded refrigerant so that the air to be conditioned passes over the two circuits in parallel.

The sixth object of the invention is to provide a simple and inexpensive control system to modify the temperature of an area to be conditioned without excessive starting and stopping of the compression equipment.

Other objects and advantages of the invention will become apparent as the specification proceeds to describe the invention with reference to the drawing which shows schematically the air conditioning apparatus and controls therefor.



Referring to the drawing, it is seen that under full load conditions the compressor 10 discharges compressed refrigerant to the condenser 12 through discharge lines 14 and 16. Condenser 12 condenses the compressed refrigerant and conducts the liquid refrigerant through liquid line 18 to the expansion valve 20 which is controlled in the conventional manner by a thermal sensitive bulb 22 in the suction line 50. The refrigerant passes through the expansion valve 20, splits into two streams, one through the check valve 23 by way of conduit 24 to the upper circuit 30 of evaporator coil 28 and the other through conduit 26 to the lower circuit 32 of the evaporator coil 28. Evaporator coil 28 is shown located in a supply duct 34 transverse to the air flow induced by fan 36 but may be located in any other desired air conditioning apparatus since such location is not encompassed in my invention. The conventional evaporator pan 38 is located under the coil to catch any condensed liquid therefrom. The refrigerant exits from the evaporator coil through suction conduits 40 and 42 and is returned to the compressor 10 through suction line 50.

When the outside temperature drops, full capacity of the system will reduce the temperature of the area being conditioned to a point below that desired. Thermostat 44, preferably located in the return air stream but not restricted to such position, upon reduction of the temperature below that desired, will open solenoid valve 46 in hot gas by-pass line 48 allowing hot compressed refrigerant gas to pass through by-pass 48 to the upper circuit 30 of evaporator coil 28. The hot gas will pass through the upper circuit 30 of the coil and then return to the compressor 10 through suction conduit 40 and suction line 50. It should be noted that check valve 23 prevents feed-back of the refrigerant to the expansion valve 20 and the lower circuit 32. The use of check valve 23 is optional since other means such as proper sizing of the refrigerant lines may be used to perform the same function. It is obvious that while hot gas is flowing in the upper circuit that the lower circuit continues to cool and dehumidify the air thereby maintaining comfortable humidity conditions without over cooling. Therefore, the operation of the hot gas by-pass 48 allows the air conditioning system to operate at reduced capacity and at the same time avoids frequent stopping and starting of the compressor. My hot gas by-pass provides an economic and simple capacity control which requires only a single evaporator coil and a single evaporator pan.

A modification of the evaporator coil 28 may be made so as to have the upper circuit 30 be on the refrigeration cycle at all times and to use the lower circuit 32 as the hot gas by-pass circuit. This modification would require the use of evaporator pans beneath both the upper circuit 30 and the lower circuit 32 of the evaporator coil 28 in order to prevent the dripping of condensate from the upper circuit on the lower circuit when operating under reduced load conditions and to receive condensation from the lower circuit when both circuits are operating under full load conditions. Condensate drip by the upper circuit on the lower circuit is not desirable when using the hot gas by-pass since the condensate evaporates when it falls on the lower circuit and thereby unnecessarily raises the humidity of the cool air supplied to the area to be conditioned. To operate with the lower circuit 32 as the hot gas by-pass circuit, the hot gas by-pass line will be teed into the refrigerant conduit 26 and the check valve 23 will be inserted in conduit 26 between the expansion valve 20 and the hot gas

by-pass connection to prevent feed back of the hot gas into other parts of the refrigerant circuit.

As disclosed herein I have provided a simple and economic refrigeration control system in which the air to be conditioned passes in parallel over an evaporator coil which is capable of modifying the temperature of at least two portions of the air flow in an unlike manner in accordance with load conditions of the air to be conditioned without excessive starting and stopping of the compressor.

Although the preferred embodiments of the invention have been specifically described, it is contemplated that many changes may be made without departing from the scope or spirit of the invention and I desire to be limited only by the claims.

I claim:

1. In an air conditioning apparatus, the combination of air circulating means and a refrigeration system to condition the air circulated by said air circulating means, said refrigeration system comprising a compressor, a condenser connected to said compressor, expansion means connected to the downstream side of said condenser, heat exchange means located transverse to the air flow created by said air circulating means, conduit means connecting said heat exchange means to said expansion means, a suction line connecting said heat exchange means and said compressor, said heat exchange means comprising a first refrigerant circuit and a second refrigerant circuit, means positioning said circuits so that a portion of the air flow created by said circulating means passes over said first circuit and another portion of said air flow passes over said second circuit portion in parallel relationship to said first portion of the air flow, said refrigerant circuits having separate refrigerant inlets connected to said conduit means and outlets connected to said suction line, hot gas bypass means connected to one of said refrigerant circuit inlets to deliver hot uncondensed refrigerant gas from said compressor to said one inlet when the temperature of the air to be conditioned has dropped below a predetermined level, and check means between said hot gas bypass and said conduit means to prevent feed back of hot uncondensed refrigerant gas to other parts of the refrigerant circuit.

2. The combination as defined in claim 1 wherein valve means is located in said hot gas by-pass means to control the passage of hot gas to said heat exchange means.

3. The combination defined in claim 1 wherein said check means comprises a check valve and wherein valve means is located in said hot gas bypass means to control the passage of hot gas to said heat exchange means.

4. In an air conditioning apparatus, the combination of a substantially horizontal air supply duct, air circulating means connected to said duct, and a refrigeration system to condition the air circulated by said air circulating means, said refrigeration system comprising a compressor, a condenser connected to said compressor,



expansion means connected to the downstream side of said condenser, heat exchange means in said air supply duct transverse to the air flow created by said air circulating means, conduit means connecting said heat exchange means to said expansion means, a suction line connecting said heat exchange means and said compressor, said evaporator having an upper and lower refrigerant circuit, said upper and lower refrigerant circuits having separate volatile refrigerant inlets connected to said conduit means and outlets connected to said suction line, hot gas bypass means connected to one of said refrigerant circuit inlets to deliver hot uncondensed refrigerant gas from said compressor to said one inlet when the temperature of the air to be conditioned has dropped below a predetermined level, and check means located between said hot gas bypass means and said conduit means to prevent feed back of the hot uncondensed refrigerant gas to other parts of the refrigerant circuit.

5. The combination defined in claim 4 wherein said hot gas bypass means is connected to the inlet of the upper refrigerant circuit.

6. In an air conditioning apparatus, the combination of air circulating means and a refrigeration system to condition the air circulated by said air circulating means, said refrigeration system comprising a compressor, a condenser connected to said compressor, expansion means connected to the downstream side of said condenser, heat exchange means located transverse to the air flow created by said air circulating means, conduit means connecting said heat exchange means to said expansion means, a suction line connecting said heat exchange means and said compressor, said heat exchange means comprising a first refrigerant circuit and a second refrigerant circuit, means positioning said circuits so that a portion of the air flow created by said circulating means passes over said first circuit and another portion of said air flow passes over said second circuit portion in parallel relationship to said first portion of the air flow, said refrigerant circuits having separate refrigerant inlets connected to said conduit means and outlets connected to said suction line, hot gas bypass means connected to one of said refrigerant circuits to deliver hot uncondensed refrigerant gas from said compressor to said circuit when the temperature of the air to be conditioned has dropped below a predetermined level, and check means between said hot gas bypass and said conduit means to prevent feed back of hot uncondensed refrigerant gas to other parts of the refrigerant circuit.

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