

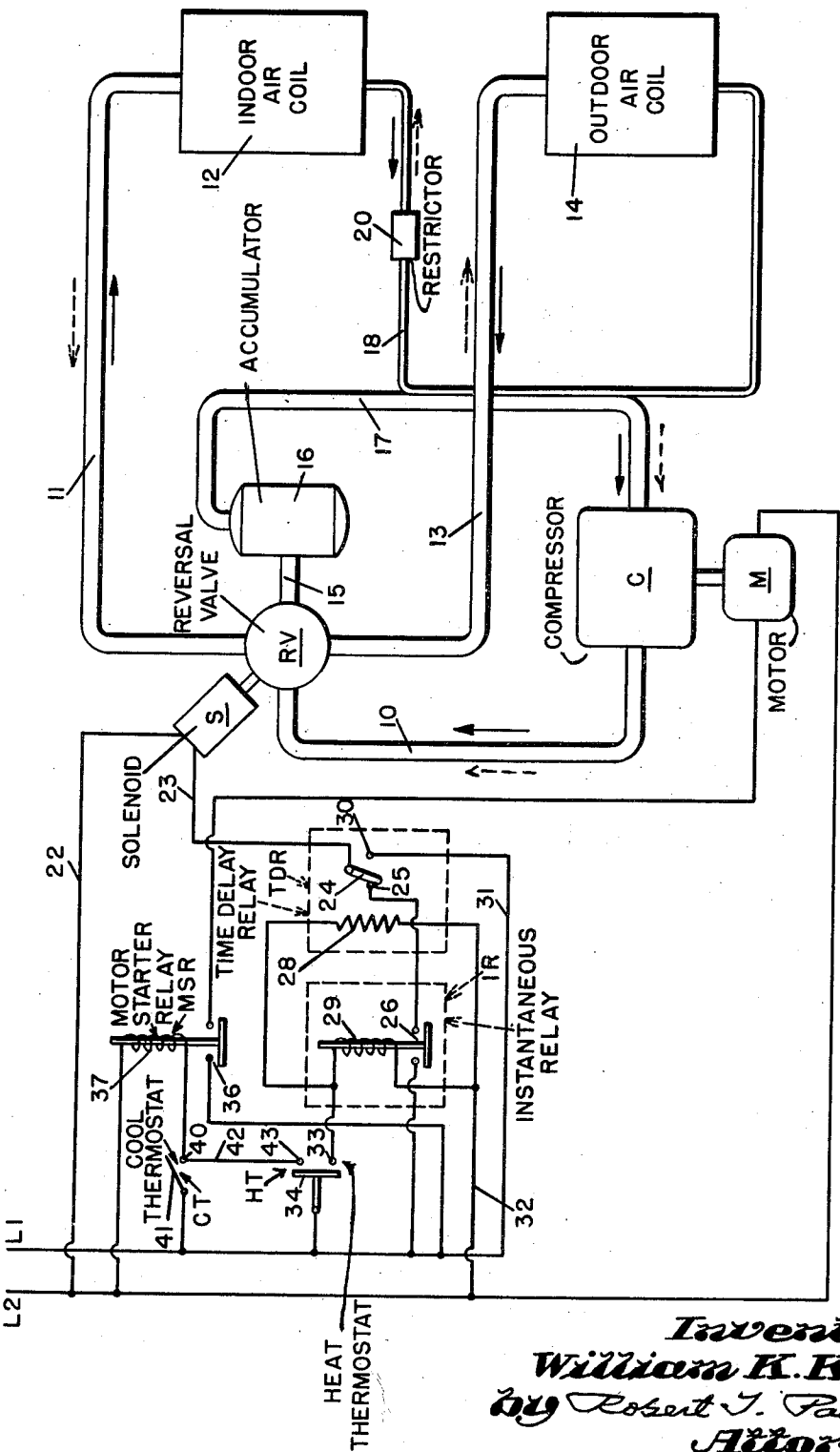
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CONTROLS FOR HEAT PUMPS

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CONTROLS FOR HEAT PUMPS

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This invention relates to heat pumps that are used for heating or cooling indoor air.

Heat pumps that are used for cooling or heating indoor air usually consist of motor driven refrigerant compressors that are connected through solenoid adjusted, refrigerant reversal valves to indoor coils and to outdoor coils. When indoor air cooling is required, the reversal valve is adjusted to route refrigerant from a compressor through an outdoor coil acting as a condenser coil, and then through refrigerant expansion means into an indoor coil acting as an evaporator coil. When indoor air heating is required, the reversal valve is adjusted to route refrigerant from the compressor through the indoor coil acting as a condenser coil, and then through expansion means into the outdoor coil acting as an evaporator coil.

Some such heat pumps have heat thermostats which act to energize solenoids to adjust the refrigerant reversal valves to indoor air heating positions, and to cycle the compressors when indoor air heat is required, and which act to deenergize the solenoids for causing the reversal valves to move to indoor air cooling positions when no indoor air heating is required. The cool thermostats of such heat pumps cycle the compressors only. In such a heat pump, when the heat thermostat is satisfied after a period of indoor air heating, it stops the compressor motor and deenergizes the solenoid of the reversal valve to cause the valve to switch to its indoor air cooling position. At such a time, the high pressure gas in the indoor coil is released through the compressor into the outdoor coil, producing objectionable noise.

This invention prevents or greatly reduces such a noise by maintaining the reversal valve in its indoor air heating position for a period of time after the heat thermostat has acted to reverse it, sufficient for the high pressure within the indoor coil to be reduced, thus preventing the rush of high pressure gas through the compressor into the outdoor coil. Time delay relay means is used to deenergize the solenoid a period of time after the heat thermostat has opened its switch, sufficient for the pressures in the indoor and outdoor coils to equalize. Such a time delay means must be of the instantaneous make type so that indoor heat can be produced quickly when required, and of the slow break type for delaying the adjustment of the reversal valve from its air heating position. The available relays having these characteristics are relatively expensive—in the \$30.00 range. A feature of this invention is that an instantaneous make-break relay costing about \$1.25 is used with a slow make-slow break relay costing about \$2.25 to provide the instantaneous make and slow break action required.

An object of this invention is to reduce the noise resulting from the adjustment of a reversal valve of a heat pump from heating to cooling position.

Another object of this invention is to provide inexpensive instantaneous make and slow break relay means for quickly energizing the solenoid of a reversal valve of a heat pump to adjust the valve to its heating position, and for delaying the deenergization of the solenoid.

This invention will now be described with reference to the annexed drawing which is a diagrammatic view of a heating pump system embodying this invention.

A refrigerant compressor C driven by an electric motor M is connected through tube 10 to a conventional

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refrigerant reversal valve RV adjustable by solenoid S from indoor air cooling to indoor air heating positions and vice versa. The valve RV is connected by a tube 11 to indoor air coil 12, by a tube 13 to outdoor coil 14, and by a tube 15 to an accumulator 16 which is connected by a tube 17 to the suction side of the compressor. The coils 12 and 14 are connected by a capillary tube 18, serving as a two-way expansion means. The tube 18 contains a check-valve type restrictor 20 for decreasing the refrigerant flowing to the indoor coil 12 when it is acting as a condenser coil, as disclosed in the G. L. Biehn Patent No. 2,785,540. The solid line arrows show the direction of flow of refrigerant during indoor air heating, and the dashed line arrows show the direction of flow of refrigerant during indoor air cooling.

The solenoid S is connected by a wire 22 to electric supply line L2, and by wire 23 to two-way switch arm 24 of thermal time delay relay TDR. Contact 25 of the relay TDR is connected to switch 26 of instantaneous relay IR, which is connected to electric supply line L1. Heater resistor 28 of the relay TDR is connected across coil 29 of the relay IR. The other contact 30 of the relay TDR is connected by wire 31 to the supply line L1. The coil 29 is connected by wire 32 to the line L2, and is connected to contact 33 of heat thermostat HT. The switch arm 34 of the thermostat HT is connected to the line L1. The compressor motor M is connected to the supply line L2 and through switch 36 of motor starter relay MSR to the line L1. The relay MSR has an energizing coil 37 connected to the line L2 and to contact 43 of the thermostat HT and contact 40 of cool thermostat CT. Contact arm 41 of the thermostat CT is connected to the supply line L1. When the heater resistor 28 of the relay TDR is cold, the switch arm 24 rests against the contact 25.

Operation

In operation, assume that the cool thermostat is satisfied after the heat pump has been operating to cool indoor air, and its switch arm 41 leaves the contact 40. This deenergizes the motor starter relay MSR which opens its switch 36, deenergizing the compressor motor M. Assume that thereafter the heat thermostat HT calls for heat. Its switch arm 34 moves against the contacts 33 and 43. The motor starter relay MSR is energized through the connection of its coil directly to the line L2, and through the contact 43 and switch arm 34 to the line L1, and closes its switch 36, starting the compressor motor M. The relay IR is energized through the connection of its coil 29 to the line L2, and through the contact 33 and switch arm 34 to the line L1, and closes its switch 26 connecting the solenoid S to the supply line L1 through the wire 23, the switch arm 24, the contact 25 and the closed switch 26. The solenoid is already connected to the other line L2 and is energized and adjusts the reversal valve RV to its air heating position. At the same time, the heater resistor 28 is energized and after becoming fully heated, deflects the switch arm 24 so quickly from the contact 25 to against the contact 30 which is connected by the wire 31 to the line L1 that the solenoid remains in air heating position and maintains the reversal valve RV in air heating position.

When the reversal valve is so switched to air heating position, the compressor motor M has previously been stopped by the cool thermostat so that the pressures between the high and low sides of the compressor have had time to equalize so that there is no noise produced by the switching in this direction.

When the heat thermostat HT is satisfied, its switch arm 34 leaves the contacts 33 and 43. The switch arm 34 leaving the contact 43 deenergizes the motor starter

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relay MSR and stops the compressor motor M. The switch arm 34 leaving the contact 33 deenergizes the relay IR which opens the switch 26 disconnecting the contact 25 from the supply line L1. At the same time, the heater resistor 28 of the time delay relay TDR is deenergized. The resistor 28 cools, but a period of time is required for it to have dissipated sufficient heat to permit the switch arm to leave the contact 30 and deenergize the solenoid S. The reversal valve RV thus remains in its indoor air heating position after the heat thermostat is satisfied for a period of time sufficient for the pressure between the high and low sides of the compressor to have equalized so that there is no noise caused by the rush of high pressure gas into the low side of the compressor when the reversal valve switches to its heating position.

What is claimed is:

1. A heat pump comprising an indoor air coil, an outdoor air coil, a refrigerant compressor, an electric motor for driving said compressor, means including a refrigerant reversal valve for connecting said coils to said compressor, a solenoid for adjusting said valve to route refrigerant from said compressor to said outdoor coil and then to said indoor coil or to route refrigerant from said compressor to said indoor coil and then to said outdoor coil, a first thermostat, electric supply connections, means including said thermostat for connecting said motor to said connections, relay means, a normally open quick make switch which closes when said relay means is energized, a normally closed slow break switch which opens when said relay means is energized, a second thermostat, means including said second thermostat for connecting said motor and said relay means to said connections, and means including said switches in series for connecting said solenoid to said connections.

2. A heat pump comprising an indoor air coil, an outdoor air coil, a refrigerant compressor, an electric motor for driving said compressor, means including a refrigerant reversal valve for connecting said coils to said compressor,

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a solenoid for adjusting said valve, said solenoid when deenergized adjusting said valve to route refrigerant from said compressor to said outdoor coil and then to said indoor coil and when energized adjusting said valve to route refrigerant from said compressor to said indoor coil and then to said outdoor coil, a first thermostat for controlling said heat pump during air cooling operation, electric supply connections, means including said thermostat for connecting said motor to said connections, relay means, having a normally open quick make switch which closes when said relay means is energized, a normally closed slow break switch which opens when said relay means is energized, a second thermostat for controlling said heat pump during air heating operation, means including said second thermostat for connecting said motor and said relay means to said connections, and means including said switches in series for connecting said solenoid to said connections.

3. A heat pump comprising an indoor air coil, an outdoor air coil, a refrigerant compressor, an electric motor for driving said compressor, means including a refrigerant reversal valve for connecting said coils to said compressor, a solenoid for adjusting said valve to route refrigerant from said compressor to said outdoor coil and then to said indoor coil or to route refrigerant from said compressor to said indoor coil and then to said outdoor coil, a first thermostat, electric supply connections, means including said thermostat for connecting said motor to said connections, a first relay having a quick make switch, a second relay having a slow break switch, a second thermostat, means including said second thermostat for connecting said motor and said relays to said connections, and means including said switches for connecting said solenoid to said connections.

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