

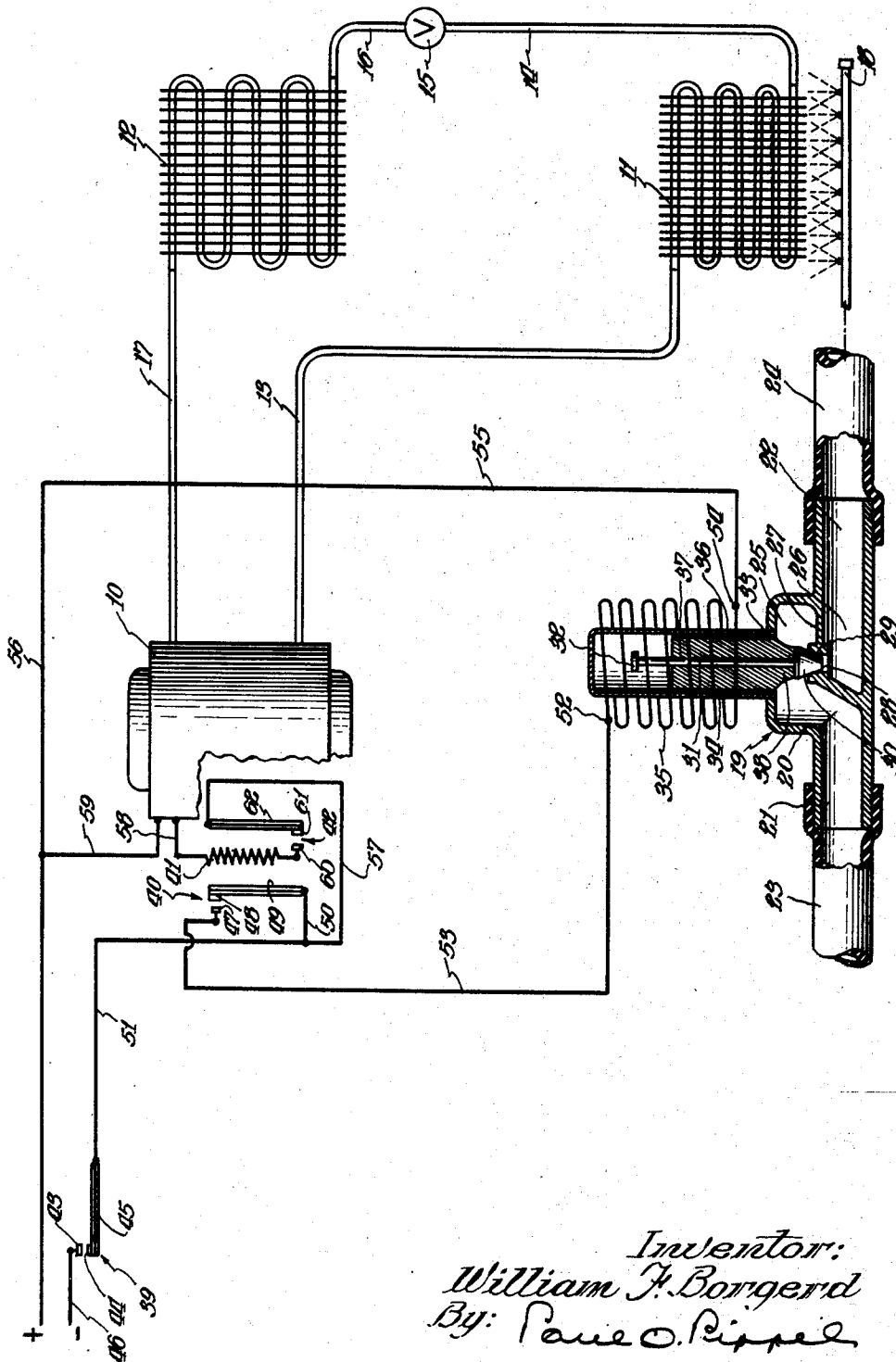
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W. F. BORGERD

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CONTROL SYSTEM FOR REFRIGERANT CONDENSING UNITS

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Inventor:
William F. Borgerd
By: Paul C. Rippe
Attorney

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CONTROL SYSTEM FOR REFRIGERANT
CONDENSING UNITSWilliam F. Borgerd, Evansville, Ind., assignor to
International Harvester Company, a corpora-
tion of New Jersey

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3 Claims. (Cl. 62-4)

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The present invention relates generally to a control system and more particularly to a control system for regulating the spraying of water over the exterior surfaces of an air cooled condenser or an evaporative condenser.

By providing a refrigeration system with means for spraying water over the exterior surfaces of an air cooled condenser, the condenser can be quickly cooled from excessively high temperatures. The condenser is normally cooled by air and the water is only used during abnormally high load periods such as might be occasionally encountered during hot summer months. In areas where water is expensive or scarce air cooling of the condenser is very desirable. As the water is sprayed over the hot surfaces of the condenser it absorbs heat therefrom and is evaporated which effectively cools the condenser. Since many refrigeration systems are designed so as to require a minimum of attention from an operator, it is desirable to provide a water spray system with control means for automatically regulating the flow of spray water over the condenser. It is understood that this water should be relatively free of minerals since intermittent operation tends to form deposits more readily than if abundant spray water is constantly used. The control means may be responsive to either the high side pressure or high side temperature since both will rise during overload conditions. It has been found that control means responsive to the high side temperature are more practical since they can be positioned adjacent a member of the high side without the necessity of connecting into the refrigeration system. This permits ease of assembly and reduces the cost of servicing since it is not necessary to disturb the refrigeration system.

One object of the present invention is to provide a refrigeration system with a water spray system for cooling an air cooled condenser during overload conditions.

Another object of the invention is to provide the water spray system with a solenoid inlet valve which regulates the flow of water through the system.

A further object of the invention is to provide thermostatic means, positioned adjacent a high side member of the refrigeration system, for controlling the solenoid inlet valve so that the flow of water is regulated in response to the temperature of the high side.

A still further object is to provide a refrigeration system with an overload protector which will automatically stop the operation of the system when the high side temperature reaches a predetermined maximum temperature.

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Other objects and advantages of the invention will appear as the description proceeds, reference being had to the accompanying drawings wherein a preferred form of the invention is shown. It is to be understood, however, that the drawing and description are illustrative only and are not to be taken as limiting the invention except in so far as it is limited by the claims.

The single figure of the drawing is a diagrammatic view of a refrigeration system provided with an automatically controlled water spray system.

Referring to the drawing for a more detailed description of the invention, a refrigeration system is diagrammatically shown comprising a motor-compressor unit 10, an air cooled condenser 11, and an evaporator 12. After the refrigerant gas is compressed by the motor-compressor unit 10, it passes through conduit 13 into condenser 11 where it flows through the finned tubes of the condenser and loses heat to the cooling air which is circulated over the exterior surfaces of the condenser. The refrigerant gas is condensed in the condenser and then flows through conduit 14 to expansion valve 15 or other pressure reducing device where it passes from the high side to the low side in the usual manner. From expansion valve 15 the refrigerant flows through conduit 16, evaporator 12 and conduit 17 into the motor-compressor unit to repeat the cycle. The evaporator is adapted to be placed in an enclosure to be cooled, and the air to be conditioned is passed into heat exchange relationship with the exterior surfaces of the evaporator. That part of the refrigeration system comprising the motor-compressor unit 10, conduit 13, condenser 11 and conduit 14 is commonly termed the high side of the system since the refrigerant in these members is maintained at a high pressure. The refrigerant in conduit 16, evaporator 12 and conduit 17 is maintained at a low pressure and this part of the system is termed the low side.

Positioned adjacent the condenser 11 is a spray nozzle 18 from which a fine spray of water may be ejected onto the exterior surfaces of the condenser 11. During normal operating conditions, the condenser will be cooled only by the cooling air which circulates thereover. However, if overload conditions are encountered, the temperature and pressure of the high side will rise. As water is sprayed over the condenser 11 by nozzle 18, the water will absorb heat from the hot surfaces of the condenser and be evaporated. Since considerable heat will be removed as the water changes from a liquid to a vapor, only a relatively small quantity of water will be need-

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ed to effectively cool the condenser and reduce the temperature and pressure of the high side to normal values. Conservation of water is an important factor in many localities and will probably become more important in the future.

The present invention provides a solenoid valve 19 for controlling the flow of water from nozzle 18. The valve comprises a valve body 20 having a water inlet 21 and a water outlet 22. A rubber hose 23 connects the water inlet 21 to a suitable water supply and a second rubber hose 24 connects the water outlet 22 to the spray nozzle 18. The valve body 20 is provided with an inlet chamber 25 and an outlet chamber 26 which are separated by a wall member 27. A valve port 28 extends through wall member 27 and is provided with a conical shaped valve seat 29. A conical shaped valve member 30 is positioned above valve seat 29 so that it may be moved into engagement with the valve seat in order to close valve port 28. The valve member 30 is also adapted to be moved away from the valve seat 29 which opens the valve port 28. The lower end of a vertically extending valve stem 31 is secured to valve member 30 and the upper end is provided with a circular shaped head 32. The valve stem extends upwardly through an opening 33 provided in valve body 20.

A non-magnetic cylindrical shaped housing 34 encloses the upper portion of the valve stem with the lower open end fitted into opening 33 and secured to valve body 20 in sealed relationship. An energizing coil 35 is disposed about the housing 34 and secured thereto in any suitable manner. A cylindrical shaped armature member or plunger 36 is disposed within the housing 34 and is reciprocally movable therein upon energization or deenergization of the coil 35. The plunger 36 is provided with an internal bore 37 which fits over valve stem 31 in sliding relationship. When the coil 35 is not energized, the lower end 38 of the plunger will contact member 30 and the weight of valve member 30, valve stem 31 and plunger 36 will force the valve member into engagement with valve seat 29. This closes the valve port 28 and prevents water from flowing therethrough. When the coil 35 is energized, a magnetic field is set up which lifts plunger 36. In its upward travel the plunger 36 strikes the valve stem head 32 a sharp blow and moves the valve stem 31 and valve member 30 upward. As the valve member 30 moves away from valve seat 29, the valve port 28 will be opened and water will flow therethrough.

The electric circuit for the coil 35 and the electric motor of motor-compressor unit 10 comprises a room thermostat 39, thermostatic switch 40, electrical resistor 41, and thermostatic switch 42. The room thermostat 39 is positioned within the enclosure containing evaporator 12 so that it will be subjected to the temperatures of the air being conditioned. In the illustrated embodiment the thermostatic switches 40 and 42 and resistor 41 are all mounted in close proximity to the motor-compressor unit. They could be positioned within a small housing attached to a portion of the compressor so that they would be subjected to the temperature of the high side.

Room thermostat 39 comprises fixed contact 43 and contact 44 which is secured to the movable end of a bimetallic strip 45. Wire 46 connects contact 43 to a suitable electric supply source. Thermostatic switch 40 comprises fixed contact 47, movable contact 48 and a bimetallic strip 49. Contact 48 is secured to the movable

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end of bi-metallic strip 49 and is electrically connected by wires 50 and 51 to contact 44 of the room thermostat 39. Terminal 52 of coil 35 is connected to contact 47 by wire 53 and terminal 54 is connected to the power supply by wires 55 and 56. The motor-compressor unit 10 is connected in parallel with the coil 35 by wire 57, thermostatic switch 42, resistor 41, wire 58 and wire 59. The switch 42 comprises fixed contact 60 and contact 61 which is mounted on the movable end of a bi-metallic strip 62. Switches 40 and 42 are mounted adjacent resistor 41 so that the heat generated by the resistor will affect the bi-metallic strips 49 and 62.

The operation of the system will now be explained. When the temperature of the enclosure in which the evaporator 12 is positioned has risen to a predetermined value, the bi-metallic strip 45 of room thermostat 39 will bend and contact 44 will be moved into engagement with contact 43. If the temperature of the high side is within a normal range, bi-metallic strip 62 of switch 42 will be bent so that contact 61 will be in engagement with contact 60. This completes the circuit to motor-compressor unit 10 from the power supply through wire 46, room thermostat 39, wire 51, wire 57, thermostatic switch 42, resistor 41 and wire 58, and back to the power supply through wires 59 and 56. As the circuit is completed, the refrigeration system will begin to operate and the air within the enclosure will be cooled as it circulates over the evaporator 12.

If the condenser 11 does not properly cool the refrigerant, the high side pressure and temperature will rise and resistor 41 will be heated due to the increased current flow to the motor-compressor unit 10. The heat from the resistor 41 and motor-compressor unit 10 will cause the bi-metallic strip 49 of switch 40 to bend until contacts 47 and 48 are touching. This completes the circuit to the coil 35 from the power supply through wire 46, room thermostat 39, wire 51, wire 50, thermostatic switch 40 and wire 53, and back to the power supply through wires 55 and 56. As the coil 35 is energized, plunger 36 will be lifted upward and valve member 30 will be moved away from valve seat 29. This permits water to flow through valve port 28 to spray nozzle 18, from which it will be sprayed onto the condenser 11. Nozzle 18 will continue to spray water onto the condenser until the high side temperature is lowered to a safe operating range. Bi-metallic strip 49 of switch 40 will then bend until contacts 47 and 48 are apart which breaks the circuit to the coil 35. Coil 35 is then deenergized which closes valve port 28 and stops the flow of water to nozzle 18.

If for some reason a water supply does not exist in hose 23, no relief from the excessive load conditions will occur and the temperatures of the high side and resistor 41 will continue to rise until bi-metallic strip 62 of switch 42 has been subjected to a predetermined temperature which causes it to bend and move contact 61 away from contact 60. This breaks the circuit to the motor-compressor unit 10 and stops the refrigeration system. After the temperature of the high side has returned to a safe operating range, the bi-metallic strip 62 will bend to its original position with contact 60 in engagement with contact 61. Manual means may be provided for resetting switch 42 after the operator has located the reason for no water supply. Since the coil 35 is connected in parallel with the motor-compressor unit 10, water will continue to spray from the

nozzle 18 until the temperature of the high side has been lowered. It may be desirable to direct part of the water spray over the motor-compressor unit 10 in order to insure that it is cooled as rapidly as the condenser 11.

As can be understood from the preceding description, a refrigeration system is provided with a water spray system which will effectively cool an air cooled condenser during overload conditions. The solenoid valve 19 will effectively regulate the flow of water over the condenser 11, and the thermostatically controlled circuit will accurately control the valve in response to the temperature of the high side. In the illustrated embodiment, the switch 40, resistor 41 and switch 42 are shown positioned adjacent a portion of the motor-compressor unit, but it is to be understood that they could be positioned adjacent any other member of the high side that is responsive to high side temperature and pressure, such as conduit 13 or condenser 11. While only one form of this invention has been disclosed, other forms thereof may become apparent to those skilled in the art upon reference to this disclosure and therefore this invention is to be limited only by the scope of the appended claims and prior art.

What is claimed is:

1. In a refrigeration system, the combination of a hermetically sealed casing, a compressor, a motor for the operation of said compressor, said motor and said compressor mounted within said hermetically sealed casing, a first circuit for connection to a power source, said first circuit including a thermostatic switch, a resistor, and said motor, said resistor formed to radiate quantities of heat proportional to the current therethrough, said thermostatic switch mounted in close proximity to said hermetically sealed casing and said resistor, so that any heat radiated by said resistor and any heat radiated by said hermetically sealed casing will be radiated to said thermostatic switch, a condenser connected to said compressor, water spray means for cooling said condenser, a solenoid valve for controlling the operation of said spray means, a second circuit for connection to said power source, said second circuit including a second thermostatic switch and said solenoid valve, said second thermostatic switch positioned in close proximity to said resistor, so that any heat radiated from said resistor will heat said second thermostatic switch, said first thermostatic switch being biased so that the contacts thereof are closed when the heat radiated from said hermetically sealed casing and the heat radiated from said resistor are in a normal range, said second thermostatic switch being biased so that the contacts thereof are open when the heat radiated from said resistor is in a normal range.

2. In a refrigeration system, the combination comprising a motor-compressor unit mounted within a hermetically sealed casing, a condenser, an evaporator, metering means, tubing means connecting said evaporator, said metering means, and said condenser in series to said compressor, a header having a plurality of spray nozzles mounted thereto, said header mounted adjacent said condenser, a source of water connected to said header, a valve for controlling the supply of

water to said header, a solenoid connected to said valve for the operation thereof, said solenoid connected to said valve so that said valve is opened to permit water to be supplied to said header when said solenoid is energized, a first circuit for connection to a power source, said first circuit including said motor, a resistor, and a thermostatic switch connected in series, said thermostatic switch positioned in close proximity to said hermetically sealed casing and said resistor, said resistor formed to radiate quantities of heat proportional to the current therethrough, said thermostatic switch being biased so that the contacts thereof are closed when the quantity of heat radiated thereto by said resistor and by said hermetically sealed casing is below a predetermined amount, a second circuit for connection to said power source, said second circuit including a second thermostatic switch and said solenoid connected in series, said second thermostatic switch positioned in close proximity to said resistor, said second thermostatic switch being biased so that the contacts thereof are open when the heat radiated from said resistor is below a certain predetermined amount.

3. In a refrigeration system, the combination comprising a motor-compressor unit mounted within a hermetically sealed casing, a condenser connected to said compressor, water spray means for cooling said condenser, a solenoid valve for controlling the operation of said water spray means, said solenoid valve formed to permit the operation of said water spray means responsive to the energization of said solenoid valve, a first circuit for connection to a power source, said first circuit including said motor, a resistor, and a thermostatic switch connected in series, said thermostatic switch positioned in a heat exchange relationship to said hermetically sealed casing and to said resistor, said resistor formed to radiate quantities of heat proportional to the current therethrough, said thermostatic switch being biased so that the contacts thereof are closed when the quantity of heat transferred thereto by said resistor and by said hermetically sealed casing is below a predetermined amount, a second circuit for connection to said power source, said second circuit including a second thermostatic switch and said solenoid valve connected in series, said second thermostatic switch positioned in a heat exchange relationship to said resistor, said second thermostatic switch being biased so that the contacts thereof are open when the quantity of heat radiated thereto by said resistor is below a certain predetermined amount.

WILLIAM F. BORGERD.

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