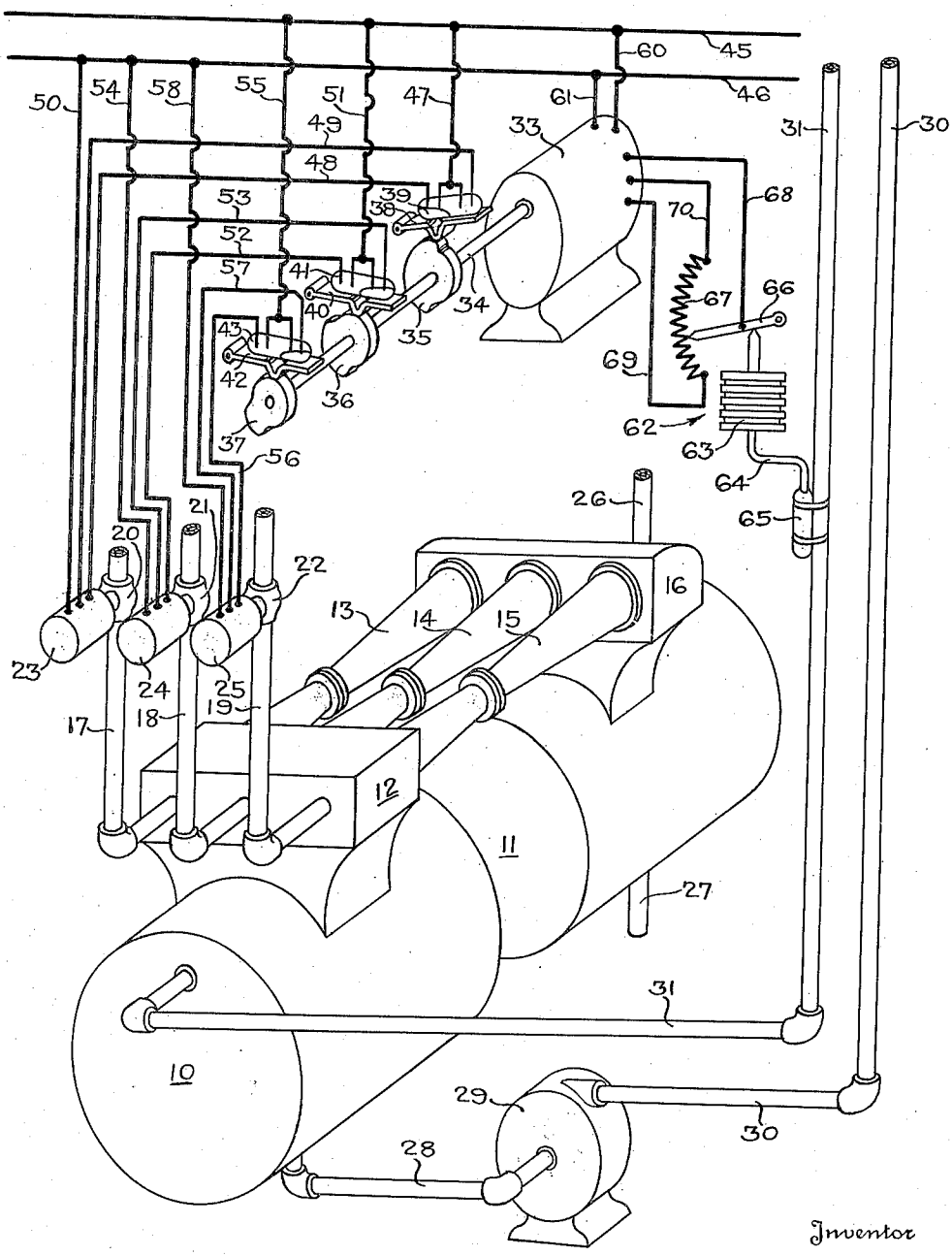
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MULTIPLE STEAM JET REFRIGERATING SYSTEM

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MULTIPLE STEAM JET REFRIGERATING SYSTEM

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This invention relates to control systems for steam jet refrigerating mechanisms and more particularly to a control system for a steam jet refrigerating mechanism having a plurality of steam jet ejectors which are to be placed sequentially in operation in accordance with the load on the refrigerating mechanism or in accordance with changes in a condition.

It is an object of this invention to provide a control system for a multiple steam jet ejector mechanism whereby various of the steam jet ejectors may be placed in operation in accordance with the load on the steam jet refrigerating mechanism or in accordance with changes in a condition. This may be accomplished by having a condition responsive device which may respond to the temperature of the cooling fluid returning to the evaporator for operating a proportioning motor. The proportioning motor may in turn operate a plurality of switching mechanisms, each of which control the supply of steam to the various steam jet ejectors, the arrangement being such that as the load on the refrigerating mechanism increases, the number of steam jet ejectors placed in operation likewise increase. The manner in which this type of control is accomplished, and the structure for accomplishing this control also form objects of this invention.

Other objects and advantages will become apparent to those skilled in the art upon reference to the accompanying specification, claims and drawing in which drawing is diagrammatically illustrated my control system as applied to a multiple steam jet ejector refrigerating mechanism.

Referring now to the drawing, an evaporator for chilling the cooling fluid is illustrated at 10 and a condenser is illustrated at 11. The evaporator 10 is provided with a nozzle box 12 which is connected by steam jet ejectors 13, 14 and 15 to a common terminal 16 which opens into a condenser 11. Steam is supplied to the ejectors 13, 14 and 15 through pipes 17, 18 and 19, respectively, leading from some source of steam, not shown. The supply of steam through these pipes 17, 18 and 19 is controlled by valves 20, 21 and 22, respectively, which are moved to an open or closed position by means of motors 23, 24 and 25, respectively. Since steam jet ejectors of this type are generally known in the art a detailed description thereof is not considered necessary, it being sufficient to state that as the steam jet ejectors 13, 14 and 15 are placed in operation, a vacuum is created within the evaporator 10 to cause chilling of the cooling fluid therein. A vacuum is also maintained within the condenser 11 to assist in condensing the steam utilized in the ejectors 13, 14 and 15 and the steam flashed in the evaporator 10. For purposes of condensing the steam in the condenser 11, condensing water from some source, not shown, may be supplied to the condenser 11 through a pipe 26 and the expended condenser water may be discharged from the condenser 11 by a pipe 27.

Chilled cooling fluid is drawn from the evaporator 10 through a pipe 28 by a circulating pump 29 and is delivered through a pipe 30 to a point of use, not shown. The expended cooling fluid is returned from the point of use through a pipe 31 to a spray located within the evaporator 10 all of which is old in the art.

This invention contemplates the use of a proportioning motor 33 which may be of the type shown and described in Patent No. 1,989,972 issued to Lewis L. Cunningham on February 5, 1935. This proportioning motor is adapted to operate a shaft 34 which carries spaced cams 35, 36 and 37. The spaced cams have high and low dwells for operating pivoted levers 38, 40 and 42, respectively. The levers 38, 40 and 42 carry double ended mercury switches 39, 41 and 43, respectively. The cams 35, 36 and 37 are so adjusted with respect to each other that upon clockwise rotation of shaft 34, as viewed in the drawing, the mercury switch 39 will first be tilted by the high dwell of cam 35, then the mercury switch 41 will be tilted by the high dwell of cam 36 and then the mercury switch 43 will be tilted by the high dwell of cam 37. Upon counterclockwise rotation of the shaft 34, the mercury switch 43 will first be returned to its normal position, then the mercury switch 41 and then the mercury switch 39.

Line wires leading from some source of power, not shown, are designated at 45 and 46. The line wire 45 is connected by a wire 47 to the common terminal of mercury switch 39. The left-hand and right-hand electrodes of the mercury switch 39 are connected by wires 48 and 49, respectively, to the motor 23 which controls the operation of the valve 20. The motor 23 is also connected by wire 50 to the other line wire 46, the arrangement being such that when the low dwell of cam 35 is effective, the mercury within the mercury tube 39 bridges the right contacts of the mercury switch to cause operation of the valve motor 23 to move the valve 20 to a closed position. When the high dwell of cam 35 becomes effective, the mercury in the mercury switch 39 bridges the left-hand electrodes to cause operation of the motor 23 to open the valve 20.

In a like manner, the mercury switch 41 is connected by a wire 51 to the line wire 45 and by wires 52 and 53 to the valve motor 24 which opens and closes the valve 21. The valve motor 24 is connected by a wire 54 to the other line wires 46. Also, the mercury switch 43 is connected by a wire 55 to the line wire 45 and by wires 56 and 57 to the valve motor 25 which

opens and closes the valve 22. The valve 25 is also connected by a wire 58 to the other line wire 46. With the shaft 34 in the extreme counter-clockwise position, the low dwells of all of the cams 35, 36 and 37 will be effective to maintain the valves 20, 21 and 22 in closed position. Clockwise movement of the shaft 34 first tilts the mercury switch 39 to cause operation of the motor 23 to cause opening movement of the valve 20. Further movement of the shaft 34 in a clockwise direction causes the high dwell of cam 36 to tilt the mercury switch 41 which causes operation of the valve motor 24 to cause opening movement of the valve 21. Still further clockwise movement of the shaft 34 causes tilting of the mercury switch 43 to cause operation of the motor 25 to move the valve 22 to an open position. Counterclockwise movement of the shaft 34 from the extreme clockwise position first causes closing of the valve 22, then of the valve 21, and lastly of the valve 20.

Power is supplied to the proportioning motor 33 by wires 60 and 61 connected across the line wires 45 and 46. A condition responsive device is generally designated at 62 and may comprise a bellows 63 connected by a capillary tube 64 to a bulb 65 responding to a condition. Preferably, the bulb 65 is placed in intimate contact with the cooling fluid returning from the point of use to the evaporator, the temperature of this cooling fluid being varied in accordance with changes of load on the refrigerating mechanism. An increase in the temperature of the cooling fluid returning to the evaporator indicates an increase in load on the refrigerating mechanism and a decrease in temperature indicates a decrease in load on the refrigerating mechanism. The bellows 63 is adapted to operate a slider 66 with respect to a potentiometer coil 67. The slider 66 is connected by a wire 68 to the proportioning motor 33 and the ends of the potentiometer coil 67 are connected by wires 69 and 70 to the proportioning motor 33. Upon an increase in the tension of the cooling fluid returning to evaporator 10, the bellows 63 is expanded to move the slider 66 upwardly with respect to the potentiometer coil 67. This causes operation of the proportioning motor 33 to move the shaft 34 in a clockwise direction, the amount of clockwise movement of the shaft 34 being dependent upon the increase in the cooling fluid temperature. Upon a decrease in cooling fluid temperature, the bellows 63 contracts to move the slider 66 downwardly with respect to the potentiometer coil 67. This downward movement causes operation of the proportioning motor 33 to move the shaft 34 in a counter-clockwise direction, the amount of counter-clockwise movement being dependent upon the decrease in the temperature of the cooling fluid returning to evaporator 10. Therefore, it is seen that the proportioning motor is positioned in accordance with changes in temperature in the cooling fluid leading to the evaporator 10 and consequently, in proportion to changes in the load on the refrigerating system as a whole. It is therefore seen that as the temperature increases, first the steam jet ejector 13 is placed in operation, then the ejector 14, then the ejector 15 and as the temperature of the cooling fluid decreases, first the ejector 15 is placed out of operation, then the ejector 14, and then the ejector 13, the number of ejectors in operation being proportional to the load on the refrigerating mechanism as a whole. The specific manner in which the proportioning motor 33 is positioned is shown and described in detail in the above referred to Cunningham patent and therefore a complete description is not considered necessary in this application.

Although I have shown the condition responsive device 62 responsive to the temperature of the cooling fluid returning to the evaporator 10, this condition responsive device may respond to any condition which it is desirable to have control the steam jet refrigerating mechanism disclosed in this application.

Although I have shown for purposes of illustration one form of my invention, other forms thereof may become apparent to those skilled in the art and consequently this invention is to be limited only by the scope of the appended claims and the prior art.

I claim:

1. In a refrigerating system having an evaporator, a condenser and a plurality of ejectors, the combination of means for circulating cooling fluid to and from the evaporator, a steam valve for each ejector for controlling the supply of steam to the ejector, an electric motor for each valve for opening and closing the same, a switching means electrically connected to each motor for controlling the operation thereof, a proportioning motor for operating successively each switching means, thermostatic means responsive to the temperature of the cooling fluid returning to the evaporator, and variable resistance means operatively connected to the proportioning motor and adjusted by said thermostatic means to variably position said proportioning motor whereby the steam valves are opened successively in accordance with the load on the refrigerating system.

2. In a refrigerating system having an evaporator, a condenser and a plurality of ejectors, the combination of a steam valve for each ejector, an electric motor for each valve for opening and closing the same, a switching means electrically connected to each motor, a proportioning motor for operating successively each switching means, thermostatic means, and variable resistance means operatively connected to the proportioning motor and adjusted by said thermostatic means to variably position said proportioning motor whereby various of the steam valves are opened in accordance with changes in temperature.

3. In a refrigeration system having an evaporator, a condenser, and a plurality of ejectors, the combination of a steam valve for controlling the flow of steam to each ejector, an electric motor for each valve for opening and closing the same, a switching means electrically connected to each valve motor, a reversible electric motor means having an operating shaft, a thermostat for controlling said reversible electric motor means, said thermostat and said motor means being arranged for varying the angular position of said operating shaft in accordance with the cooling load on the system in a manner to provide different angular positions of said operating shaft for different values of said cooling load, and means actuated by said operating shaft for sequentially actuating said switching means, to thereby vary the number of ejectors in operation in accordance with the cooling load on the system.

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