

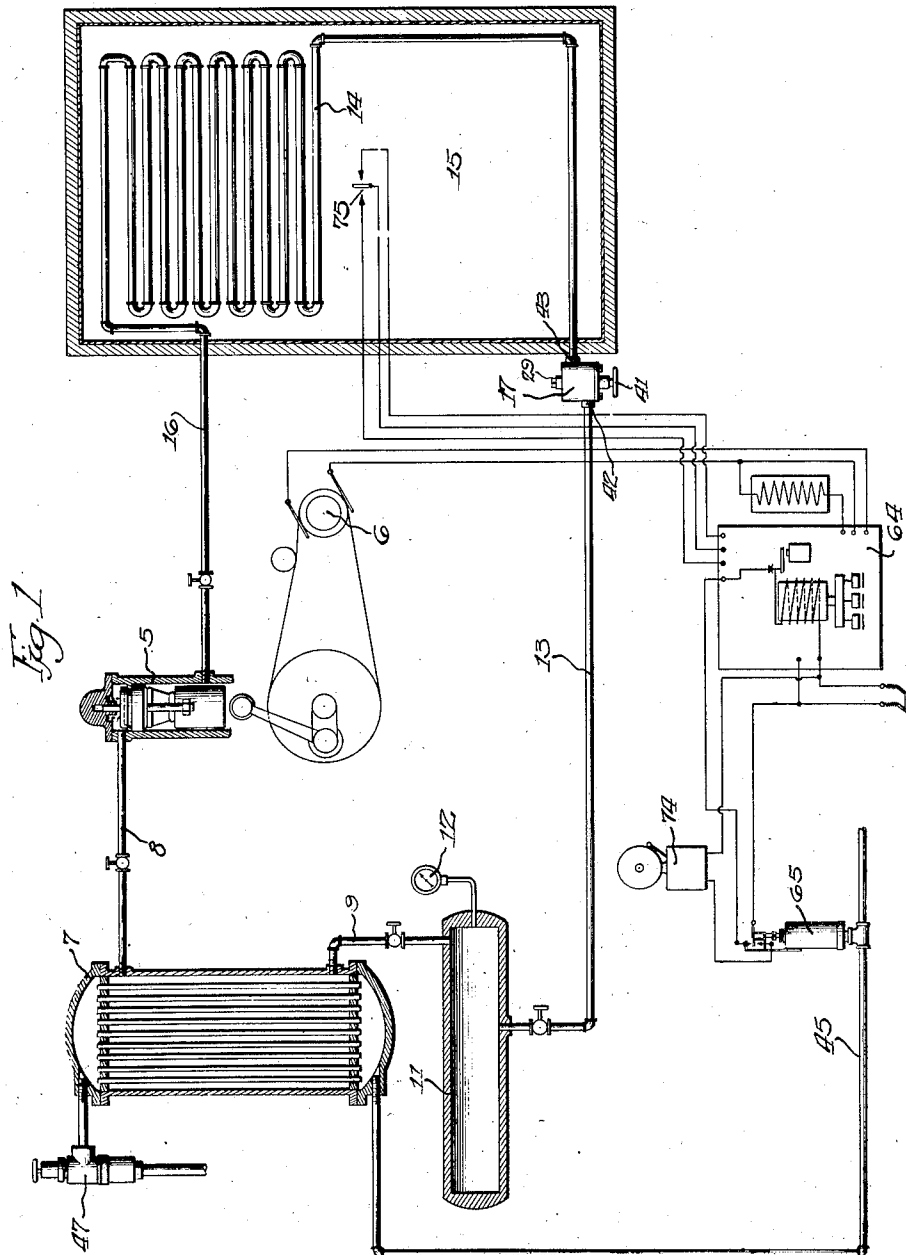
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J. C. GOOSMANN
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2 Sheets-Sheet 1



Witness:
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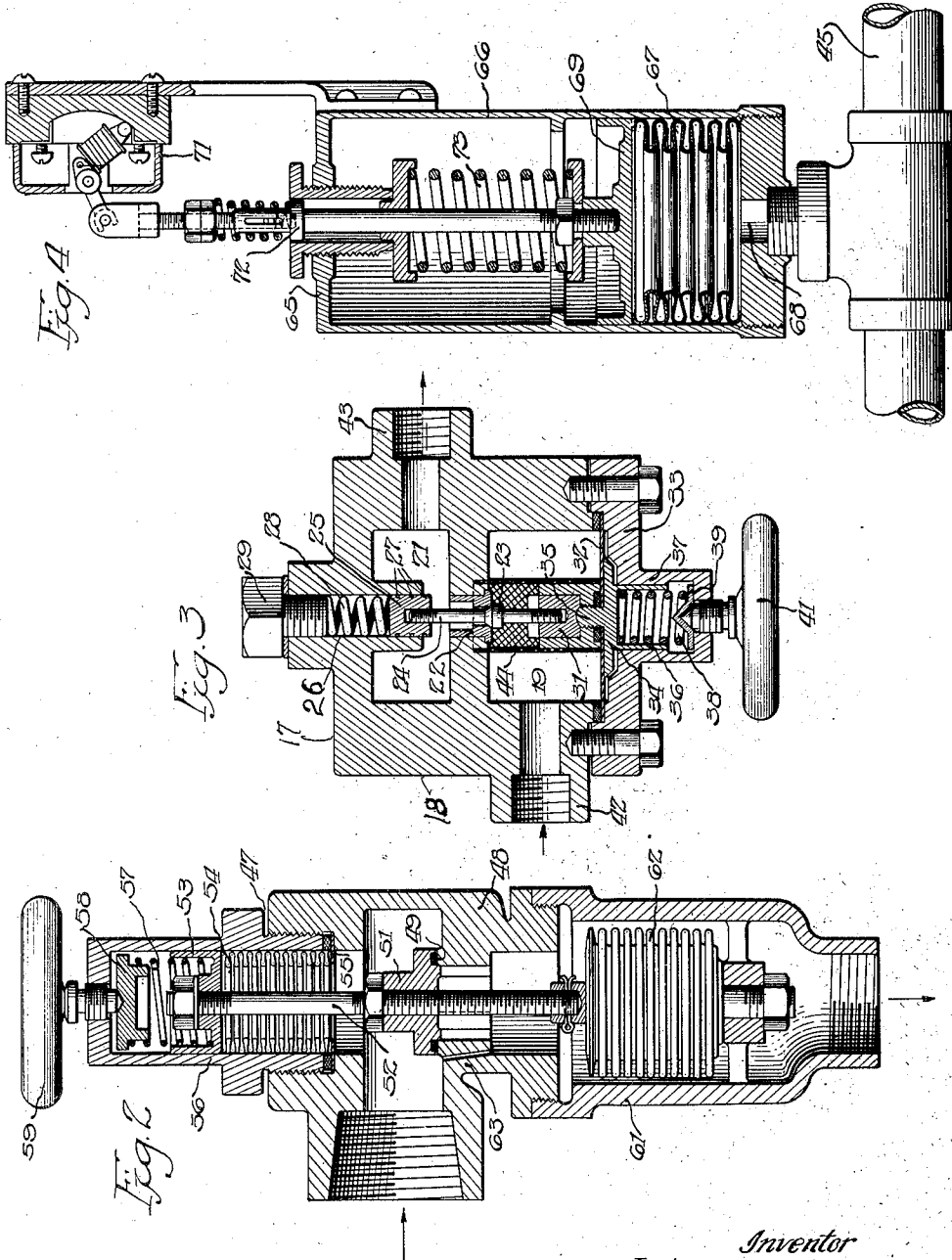
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UNITED STATES PATENT OFFICE.

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REFRIGERATING APPARATUS.

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This invention relates generally to refrigerating apparatus, and while shown, for illustrative purposes, as embodied in an apparatus of the compression type, the principles thereof may also be employed, if desired, in systems of the absorption type.

Refrigerating apparatus of either type have an expansion valve interposed in the line leading from the condenser to the evaporator, by which the flow of the refrigerating medium to the expansion coils is controlled. Customarily these valves have a fixed opening through which the refrigerating medium is permitted to pass to the evaporator in regulated quantities. The effective area of this opening is ordinarily controlled by a hand adjustable needle valve, which, when once set, permits a substantially constant flow of refrigerating medium, irrespective of the load or temperature conditions in the cold storage room. Such valves are only suitable while the refrigerating load is substantially constant, or while the system is under constant and close supervision, so that the valve may be adjusted to increase or diminish the flow, as the load upon the system varies.

In systems where such close supervision was impractical, a form of automatic expansion valve has heretofore been employed, in which the needle valve was automatically controlled by a diaphragm under the influence of the pressure in the evaporator coils. Such valves are capable of maintaining a substantially uniform pressure in the expansion coils, and are reasonably satisfactory when the load upon the system is also substantially uniform; when, however, the load varies within considerable limits, the operation of a system equipped with such a valve is inefficient and unsatisfactory, for the following reasons. If the temperature in the cold storage room is low and the load upon the system is consequently light, the liquid refrigerating medium in the expansion coils will be evaporated very slowly, the pressure in these coils will consequently be low, and since a low pressure tends to further open the expansion valve, more liquid refrigerating medium will be continually delivered into the expansion coils, with the result that the coils become heavily loaded with liquid, which is not required. This loading is objectionable for two reasons: first, there is grave danger of the liquid itself being drawn in a liquid state into the compressor, with resultant injuries to the compressor; and second, in case of ac-

cident the sudden release of this large amount of refrigerating medium in liquid condition constitutes a dangerous menace to life and property.

On the other hand, assuming that the expansion coils contain a normal amount of liquid refrigerating medium and a heavy load is suddenly imposed on the system, this liquid will be rapidly evaporated in the coils, with a resultant increase in pressure therein, which, acting upon the expansion valve, tends to close the same and reduce the flow of refrigerating medium to the coils at a time when an increased flow is required.

It should be manifest, therefore, that neither a constant flow system nor a system in which the flow to the expansion coils is controlled by the evaporator pressure can produce satisfactory and efficient refrigeration under largely varying load conditions.

One of the primary purposes of my present invention is to provide a refrigerating apparatus which will be capable of satisfactory and efficient operation under widely and rapidly varying load conditions, and will be adapted to increase the flow of refrigerating medium to the expansion coils as the refrigerating load on these coils is increased, and also to automatically decrease the flow as the refrigerating load on the coils diminishes. With these ends in view, my invention contemplates an apparatus in which the flow of refrigerating medium to the expansion coils is controlled solely by the condenser pressure, and since the condenser pressure rises or falls proportionately as the load on the expansion coils increases or diminishes, the apparatus automatically regulates itself to meet the requirements imposed by the varying load conditions.

Another purpose of this invention is to balance or govern the apparatus by automatically regulating and controlling the condenser pressures so as to maintain these pressures within predetermined reasonable limits. This result is accomplished by automatically controlling the flow of the condensing water so that such flow is increased or diminished as the condenser temperature, and consequently pressure, rises or falls, respectively.

Another object of this invention is to obviate injuries to the apparatus and the dangers resulting therefrom, which might occur if the temperature and pressures in the apparatus ran too high. This result is accomplished by means of an automatic pressure

controlled switch which is adapted to break the motor circuit and stop the apparatus in the event of failure of the cooling condensing water.

- 5 My invention also contemplates the provision of an automatic thermostatically actuated control by which the apparatus may be automatically stopped when the temperature in the storage chamber reaches a predetermined minimum, and may be automatically
10 started when said temperature rises above such minimum.

Other objects and advantages of this invention should be readily appreciated as the same becomes better understood by reference
15 to the following description, when considered in connection with the accompanying drawings.

Referring to the drawings:

- 20 Fig. 1 is a side elevation, partially in section, and somewhat diagrammatic, of a refrigerating apparatus embodying my invention;

Fig. 2 is a sectional view of the condensing
25 water control valve;

Fig. 3 is a similar view of the expansion valve; and

Fig. 4 is a similar view of the pressure controlled switch mechanism.

- 30 Referring now to the drawings more in detail, reference character 5 indicates generally the compressor, which may be of any preferred construction and driven preferably by an electric motor 6. The condenser 7,
35 which may be of any preferred type, receives the refrigerating medium delivered by the compressor through a pipe line 8. The medium condensed in the condenser is delivered through a pipe 9 into a collector or accumulator 11, preferably provided with a pressure
40 gauge 12, and from this collector the liquid medium is delivered through a pipe 13 to the expansion coils 14, located in the refrigerating chamber 15. From these coils the evaporated medium is returned to the compressor
45 through pipe line 16. The elements thus far described may be of any well known or preferred construction.

- In the pipe line 13, leading from the condenser to the evaporator coils, there is interposed an expansion valve 17, the detailed construction of which is best shown in Fig. 3. As therein illustrated, the valve comprises a casing 18, providing intake and discharge
50 chambers 19 and 21, respectively, separated by a partition wall equipped with a valve seat 22. A valve 23, adapted to close against this seat, is carried by a stem 24 having its upper end connected in a guide block 25, slidably
55 disposed in a bore 26 in the casing and equipped with circumferential pack rings 27. This guide block is normally urged downwardly by an expansion spring 28, interposed between the block and a screw plug 29, closing
60 the upper end of the bore 26. The lower end

of the valve stem is connected to a block 31 disposed above a diaphragm 32, having its circumferential margins clamped between the body and the bottom wall 33 of the casing, and this block is connected to the diaphragm
70 to move therewith through the intermediary of a member 34 provided with a threaded stud 35 and a tubular guiding portion 36, guided in the hollow boss 37 of the casing. An expansion spring 38, interposed between the
75 member 34 and a disk 39, normally urges the valve 23 against its seat, and the pressure upon the diaphragm required to unseat the valve may be regulated by manipulation of the adjusting hand wheel 41 by which the tension upon the spring 38 is varied. The liquid
80 refrigerating medium under pressure from the condenser is delivered into the chamber 19 through the nipple 42, and after passing through the valve casing is discharged therefrom to the expansion coils through the nipple 43.

The valve 23 is normally maintained in closed position by the spring 38 until the pressure of the refrigerating medium in the chamber 19 becomes sufficiently high to depress the diaphragm 32, whereupon the valve 23 is withdrawn from its seat by the downward movement of the diaphragm. The extent of opening of the valve will obviously be dependent upon the degree of pressure exerted upon the diaphragm, and consequently more or less refrigerating medium will be permitted to pass through the expansion valve as the condenser pressure rises or falls. To obviate accidental stoppage of the expansion valve opening by flakes from the iron pipe, particles of dirt, or other solid matter, a screen 44 is preferably disposed in the chamber 19 so that all refrigerating medium passing the valve
105 must flow through this screen.

The refrigerating medium delivered to the condenser by the compressor is cooled and condensed by condensing water delivered by a pipe 45 connected with any suitable source
110 of water supply. After passing through the condenser, the water is discharged through a control valve 47, the details of which are shown in Fig. 2, from which it will be observed that the valve comprises a casing 48
115 provided with a seat 49 against which a valve 51, carried by a stem 52, is adapted to close. The upper end of this stem is carried by a guiding piston 53, to the lower face of which is hermetically attached a hollow expansible and contractible member 54, hermetically attached at its lower end to a ring or disk 55, clamped against a shoulder of the valve casing by the casing cap 56. This member 54 forms a seal which, without the employment of packing or the usual stuffing boxes, precludes leakage at the upper end of the casing without binding or cramping the valve stem so as to interfere with its delicacy of operation.
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125
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The valve is normally urged toward its seat by an expansion spring 57 disposed above the piston 53 and between this piston and a member 58, the position of which may be adjusted by manipulation of a hand wheel 59 to thereby regulate the tension of the spring 57.

In the lower cylindrical portion 61 of the valve casing, which is screw threaded to the main portion 48, there is mounted a thermostatic element 62 of the expansible and contractible type, filled with a fluid having a relatively high coefficient of expansion, and the upper end of this member is connected with the valve stem 52 as shown, so that elongation of this member serves to elevate the valve 51 from its seat. A by-pass port 63 is provided around the valve, through which water flowing from the condenser passes when valve 51 is closed, to thereby influence the thermostatic element 62 and effect the initial opening of the valve 51 when the temperature of the water begins to rise. If the water flowing from the condenser is of a temperature below that for which the valve is adjusted, the valve will remain closed, thereby obviating wastage of condensing water. As the temperature of the water rises, however, due to increased temperature of the refrigerating medium delivered to the condenser by the compressor, the heated water flowing through the by-pass 63 will cause the thermostatic element 62 to expand, thereby opening the valve 51, the extent of such opening, however, being determined by the temperature of the water surrounding the thermostatic element. As the condenser temperature rises, more water will be delivered for the purpose of removing the surplus heat units from the refrigerating medium. The valve is so proportioned that the temperature, and consequently the pressure, in the condenser will be restrained within reasonable limits so as to balance or control the operation of the system as a whole.

The motor 6, which drives the compressor, receives its current through a starting and control box mechanism 64, the details of which are well known and need not be here described. In order to prevent the occurrence of excessively high temperatures and pressures in the apparatus, such as would result from failure of the supply of condensing water, I have interposed in the condensing water supply pipe 45 a pressure actuated switch control device 65, which, upon failure of the condensing water supply, automatically breaks the circuit to the motor and stops the apparatus.

This device is shown in detail in Fig. 4, from which it will be observed that within a casing 66 there is disposed a hollow expansible and contractible element 67, similar to the element 54, previously described, the interior of this element being in communication with the pressure in the condensing water

pipe 45 through a passage 68 in the bottom of the casing. A piston 69, hermetically attached to the upper end of the element 67, forms the top therefor and the position of this piston will be determined by the pressure beneath the same exerted by the condensing water. A snap switch, designated generally by reference character 71, is connected in the main supply leads to the motor, and this switch, through a suitable telescopic link 72, is connected with the piston 69. A spring 73 will urge the piston into its downward position, as shown in Fig. 4, thereby actuating the switch to open the circuit when the pressure of the condensing water lowers to a predetermined point. Normally, however, the piston will be held in elevated position by the water pressure in the pipe 45, thereby maintaining the throw-out switch 71 closed. An electric bell 74, or other signalling device, is preferably connected in the circuit so that when the apparatus is stopped by the control device just described, this signal will announce the fact to the engineer.

For purposes of economy, it is desirable to shut off the apparatus when the temperature in the refrigerating chamber 15 reaches a predetermined minimum, and to accomplish this result, a thermostatic switch, designated generally by reference character 75, Fig. 1, is located in this chamber and connected with the control box 64 in such manner that the motor supply circuit will be broken when the temperature in the chamber drops to a predetermined point and will be automatically closed to start the motor again when the temperature subsequently rises.

It is believed that the construction, operation and advantages of my invention will be understood from the foregoing without further description, and it should be obvious that the structural details illustrated and described may be varied within wide limits, without departing from the scope of the invention, as defined in the following claims.

I claim:

1. In a refrigerating apparatus, the combination with a compressor, a condenser and an evaporator connected in series, of thermostatic means for automatically controlling the condenser pressure and means controlled solely by condenser pressure for regulating the delivery of refrigerating medium to said evaporator.

2. In a refrigerating apparatus, the combination with a condenser and an evaporator connected in a closed circuit, of means for automatically controlling the condenser pressure and means controlled solely by condenser pressure for regulating the delivery of refrigerating medium to said evaporator.

3. In a refrigerating apparatus, the combination with a closed refrigerating circuit including a condenser and an evaporator, of means controlled by condenser pressure for

regulating the delivery of refrigerating medium to the evaporator, and means comprising a thermostatically actuated water control valve including an expansible sealing element for regulating the condenser temperature.

4. In a refrigerating apparatus, the combination with a closed refrigerating circuit including a condenser and an evaporator, of means controlled by the pressure in the condenser for regulating the delivery of refrigerating medium to the evaporator, a thermostatically controlled condensing water control valve for controlling the temperature in said condenser, and pressure actuated means for rendering said apparatus inoperative upon failure of condensing water.

5. In a refrigerating apparatus, the combination with a refrigerating circuit including a condenser, a compressor and an evaporator, of means controlled by the condenser pressure for regulating the delivery of re-

frigerating medium to the evaporator, a thermostatically controlled condensing water valve for automatically regulating the temperature and pressure in the condenser, means controlled by the pressure of the condensing water for rendering said apparatus operative or inoperative, and thermostatic means controlled by the temperature in the refrigerating chamber for starting and stopping said apparatus.

6. In a refrigerating apparatus, the combination with a closed refrigerating circuit including a condenser and an evaporator, and means for supplying cooling water to the condenser, of means for automatically maintaining constant the temperature of the water flowing from the condenser, and means for regulating the flow of the refrigerant within the circuit solely by the pressure of the refrigerant in the condenser.

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