Feb. 1, 1944. L. L. ASPELIN ET AL 2,340,292

AIR CONDITIONING SYSTEM

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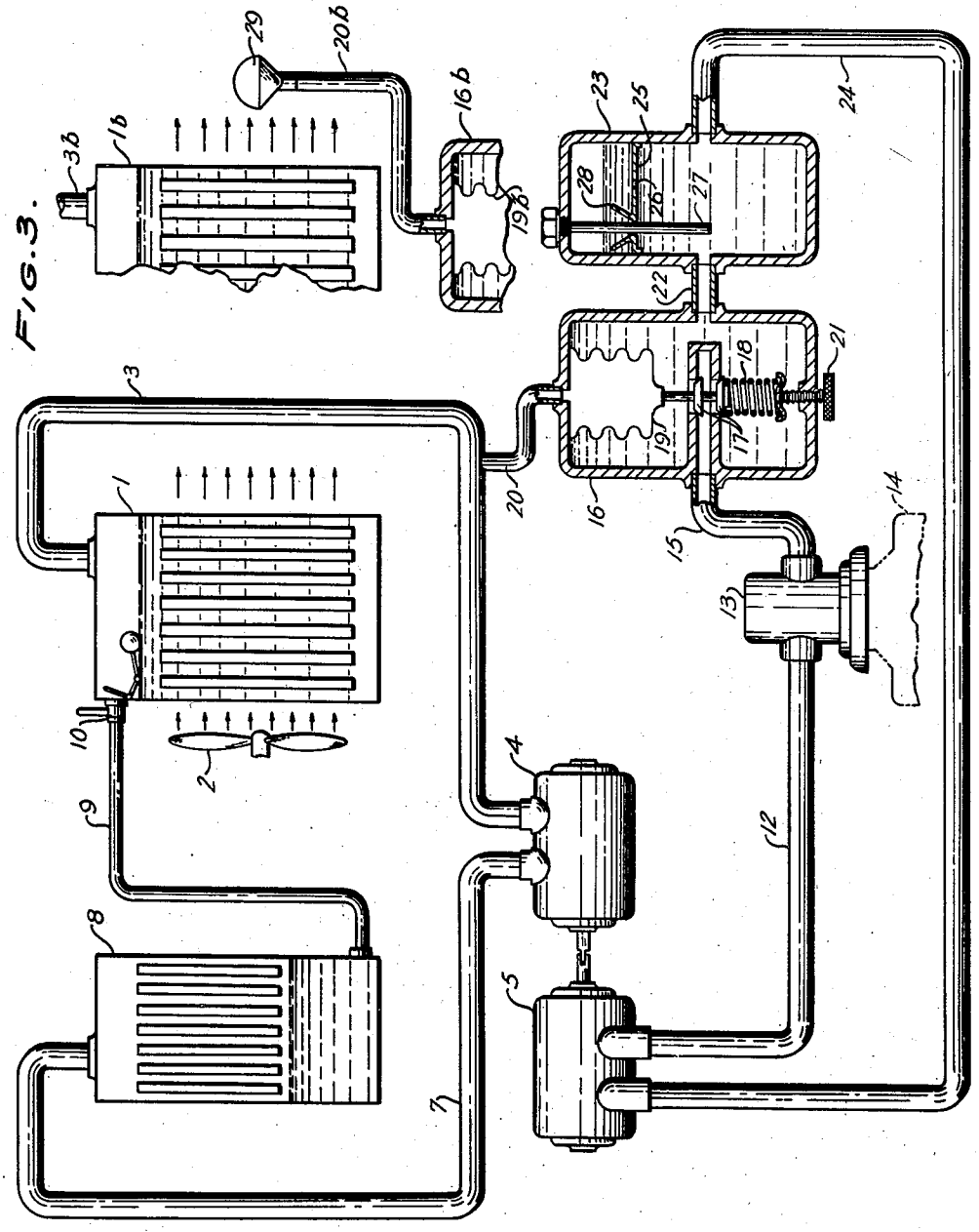


FIG. 3.

FIG. 1.

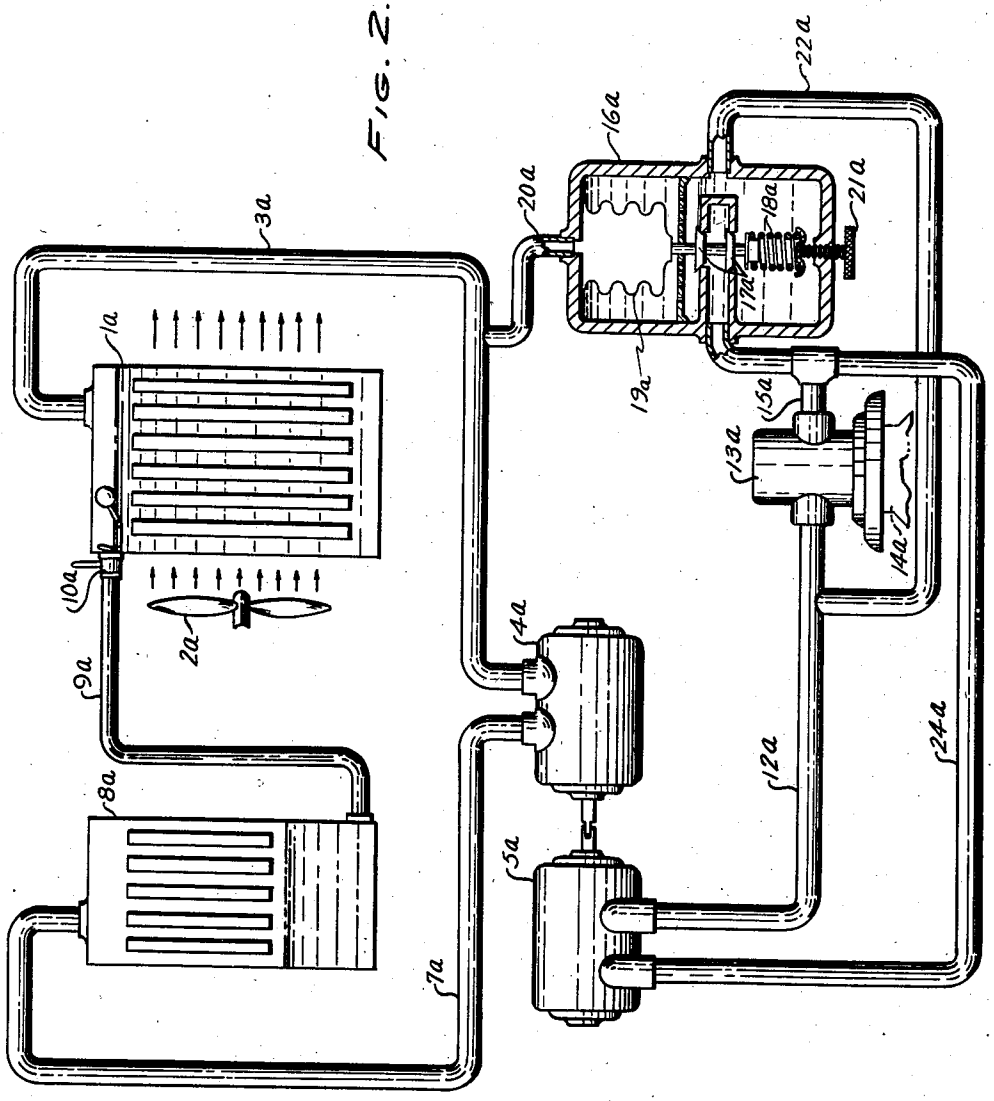
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FIG. 2.



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AIR CONDITIONING SYSTEM

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4 Claims. (Cl. 62—129)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to us of any royalty thereon.

This invention relates generally to a refrigerating or air conditioning system and more particularly to a novel combination of elements constituting a continuously operating system in which the rate of heat removal automatically responds to varying conditions.

It is an object of this invention to control the operation of a compressor in a refrigerating unit in such a manner that its operation is responsive to the load requirements or output of the unit.

It is another object of this invention to control the operation of a compressor in a continuously-operating refrigerating system in response to the capacity requirements of the system.

It is yet another object of this invention to eliminate the use of start-and-stop-compressor-driving mechanisms as well as variable-speed devices used in connection with compressor-driving mechanisms.

It is still another object of this invention to provide a compressor-driving and controlling mechanism which may be advantageously used in connection with several refrigerating units and a single condensing unit.

Referring to the drawings:

Figure 1 shows a diagrammatic layout of a refrigerating unit in combination with the fluid drive and control unit.

Figure 2 is a similar showing of a modified system.

Figure 3 is a showing of a modification of the invention.

Referring to the drawings and particularly to Figure 1, there is shown an evaporator 1 having operatively associated therewith a fan 2. Connected to the evaporator by means of tubing 3 is a compressor 4 adapted to be driven by a suitable hydraulic drive 5, the operation and control of which is to be hereinafter more fully described. Connected to the compressor by tubing 7 is a condenser and receiver 8 for receiving and storing liquid refrigerant. The refrigerant is conveyed by tubing 9 to the evaporator 1 through a suitable float valve or thermostatic expansion valve 10. As is well known in mechanical refrigeration, the compressor draws gaseous refrigerant from the evaporator 1, compresses it and forces it into the condenser and receiver 8 from where it is conveyed by conduit 9 to the evaporator 1 where, by expanding into a gaseous state, it absorbs heat to maintain the space in which the evaporator is placed at a predetermined temperature.

In the instant invention the compressor is designed to work continuously at such a variable rate as will maintain the system in a balanced condition. In other words, at such a rate that the evaporator will maintain the compartment in which it is placed at a predetermined temperature under varying heat-exchange conditions. To maintain this balanced condition, the compressor is driven at a rate responsive to the condition of the refrigerant in the evaporator 1.

The hydraulic drive for operating the compressor and the refrigerant-condition-responsive control for the drive will now be described: The fluid motor 5 comprising the hydraulic drive is operatively connected by a tubing 12 to pump 13 suitably drivingly connected to prime mover 14 such as an airplane or vehicle engine. The pump 13 is connected by tubing 15 to a regulator 16 which controls the output of the compressor by controlling the flow of driving fluid through the pump and the hydraulic drive. The regulator 16 includes a pressure-balanced valve 17 differentially positioned by spring 18 and bellows 19, the latter of which in turn is connected by tubing 20 at a suitable location to tubing 3. The tension in spring 18 may be adjusted by the spring-positioning-and-adjusting member 21 threaded into the body of regulator 16. The position of valve members 17 controlling the amount of fluid passing to the hydraulic drive is regulated by the force differential between spring 18 and the pressure in bellows 19. This pressure is, as hereinbefore explained, responsive to the pressure of the refrigerant in the line 3 and consequently the evaporator 1. Thus an increase in suction pressure in the evaporator and suction line resulting from a rise in temperature in the compartment in which the evaporator is placed will overcome the force of the spring 18 to open valve 17, allow more fluid to flow to the pump and hydraulic drive and cause the compressor to be driven at a higher rate. A reduction in pressure in bellows 19 brought about by a drop in temperature in the vicinity of the evaporator results in a relative closing movement of valve 17 and an accompanying reduction in flow of driving fluid to the pump and motor. Valve 17 may therefore be referred to as a metering valve.

Operatively connected in return lines 22 and 24 is an expansion tank 23 which in turn is divided into two chambers by partition 25 having an opening 26 therein for establishing communication therebetween. A rod-gauge 27 is provided for determining the level of oil in tank 23 and the par-

tition 25 is provided with a conical guiding portion 28 for guiding the gauge through the partition. The level of the liquid in the expansion chamber is above the partition at all times and at a level such that sufficient expansion space is provided within the chamber to accommodate surplus liquid when flow is restricted or stopped by valve 17.

In the form of the invention illustrated in Figure 2, the valve is placed across a by-pass in the line between the pump and the hydraulic drive. Similarly to the form of invention as illustrated in Figure 1, the compressor 4a, condenser 8a, valve 10a and evaporator 1a are operatively connected in series by tubing 7a, 9a, and 3a. Compressor 4a is suitably connected to hydraulic drive 5a to be driven thereby. Hydraulic drive 5a is operatively connected, by tubing 12a and 24a, to pump 13a adapted to be driven by prime mover 14a.

The regulator 16a for controlling the flow of driving fluid from pump 13a to hydraulic drive 5a is connected—by means of tubing 15a and 22a—to the pump 13a in parallel with the hydraulic drive 5a. The regulator 16a comprises a valve 17a operatively positioned by spring 18a and bellows 19a. The interior of bellows 19a is connected by tubing 20a to line 3a connecting the evaporator and the compressor. A combined adjusting screw and spring seat member 21a may be used to suitably adjust the compression in spring 18a. The position of the valve is governed by the force differential between the spring 18a and the force exerted by the bellows, which in turn is dependent upon the condition of the refrigerant in the tubing 3a. Since the pressure in bellows 19a keeps valve 17a closed against the action of spring 18a, a decrease in refrigerant pressure in line 3a results in an opening of valve 17a and a consequent reduction of fluid flow from pump 13a to hydraulic drive 5a as a result of the by-pass of fluid through the regulator. This results in a slowing down of the hydraulic drive 5a and compressor 4a and a reduction in the suction pressure in 19a until the position of valve 17a is again changed.

In a modified form of the invention as illustrated in Figure 3, the pressure in the bellows 19a is controlled by a bulb 29 having high heat transferring qualities and containing a suitable fluid. The bulb is placed directly in the path of air blown through the evaporator 1. The condition of the air blown through the evaporator 1b affects the pressure of the fluid in the bulb 29 and consequently as described in connection with the structure in Figure 1, the operation of the hydraulic drive for operating the compressor.

Although a single preferred embodiment of the invention has been described, it is to be understood that changes and modifications may be made in the device without departing from the spirit and substance of invention. Various modifications and changes may be made by those skilled in the art without departing from the inventive concept, and it is intended that the invention be limited only by the scope of the appended claims.

We claim:

1. In a refrigeration system including a compressor, a condenser and an evaporator, hydraulic means for continuously driving said compressor and means for controlling the rate of flow of fluid in the said hydraulic means to control the operation of the compressor in response to the pressure of the refrigerant in the evaporator including a balanced metering valve controlled by the pressure of the refrigerant leaving the evaporator.

2. In a refrigerating system including a condenser, an evaporator and a compressor; hydraulic means for continuously driving said compressor, pump means for continuously operating said hydraulic means, and valve means directly responsive to the pressure of the refrigerant in the evaporator for regulating and controlling the effective operation of said pump, said valve means being operatively connected to said pump means in parallel with said hydraulic means.

3. In a refrigerating system including a condenser, an evaporator and a compressor, hydraulic means for continuously driving said compressor including a pump operatively connected thereto, and means operatively connected with said pump in parallel with said hydraulic driving means and directly responsive to the pressure of the refrigerant in the evaporator for controlling the operation of the hydraulic-driving means to maintain a balanced condition in the refrigerating system.

4. A device as recited in claim 3, in which said control means includes a valve, a spring for urging said valve into open position and a bellows operatively connected to a connection between the evaporator and the compressor and responsive to the pressure therein for urging said valve into closed position.

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