

[72] Inventor **William T. Osborne**
East Syracuse, N.Y.
 [21] Appl. No **750**
 [22] Filed **Jan. 5, 1970**
 [45] Patented **June 29, 1971**
 [73] Assignee **Carrier Corp.**
Syracuse, N.Y.

[56]

References Cited

UNITED STATES PATENTS

3,315,482	4/1967	Kirtland	62/218
3,315,485	4/1967	Clark	62/218
3,315,486	4/1967	LeChien	62/218

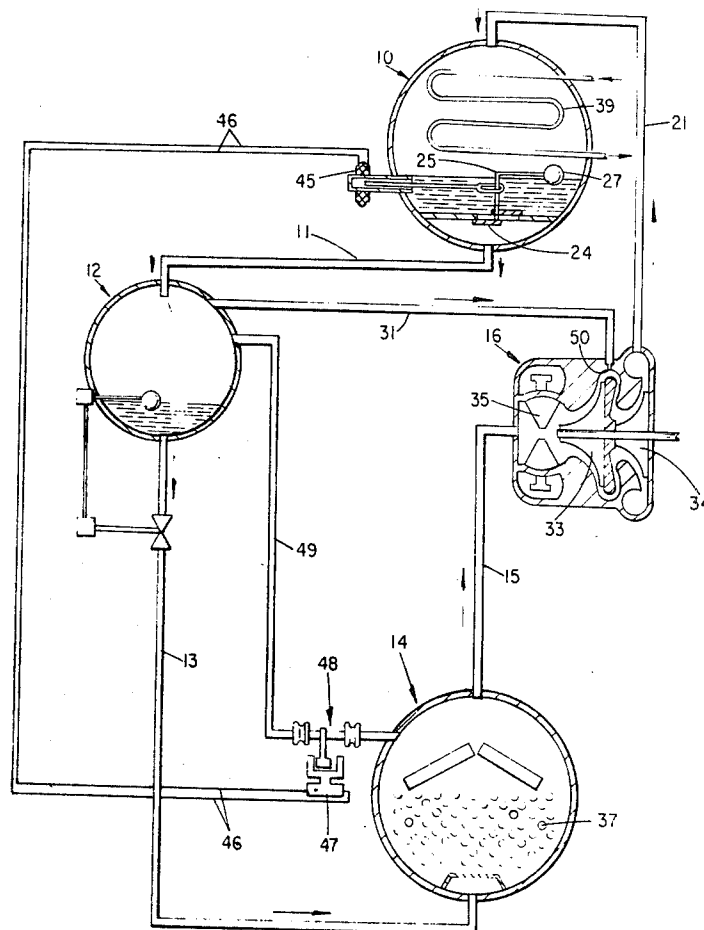
Primary Examiner—Meyer Perlin

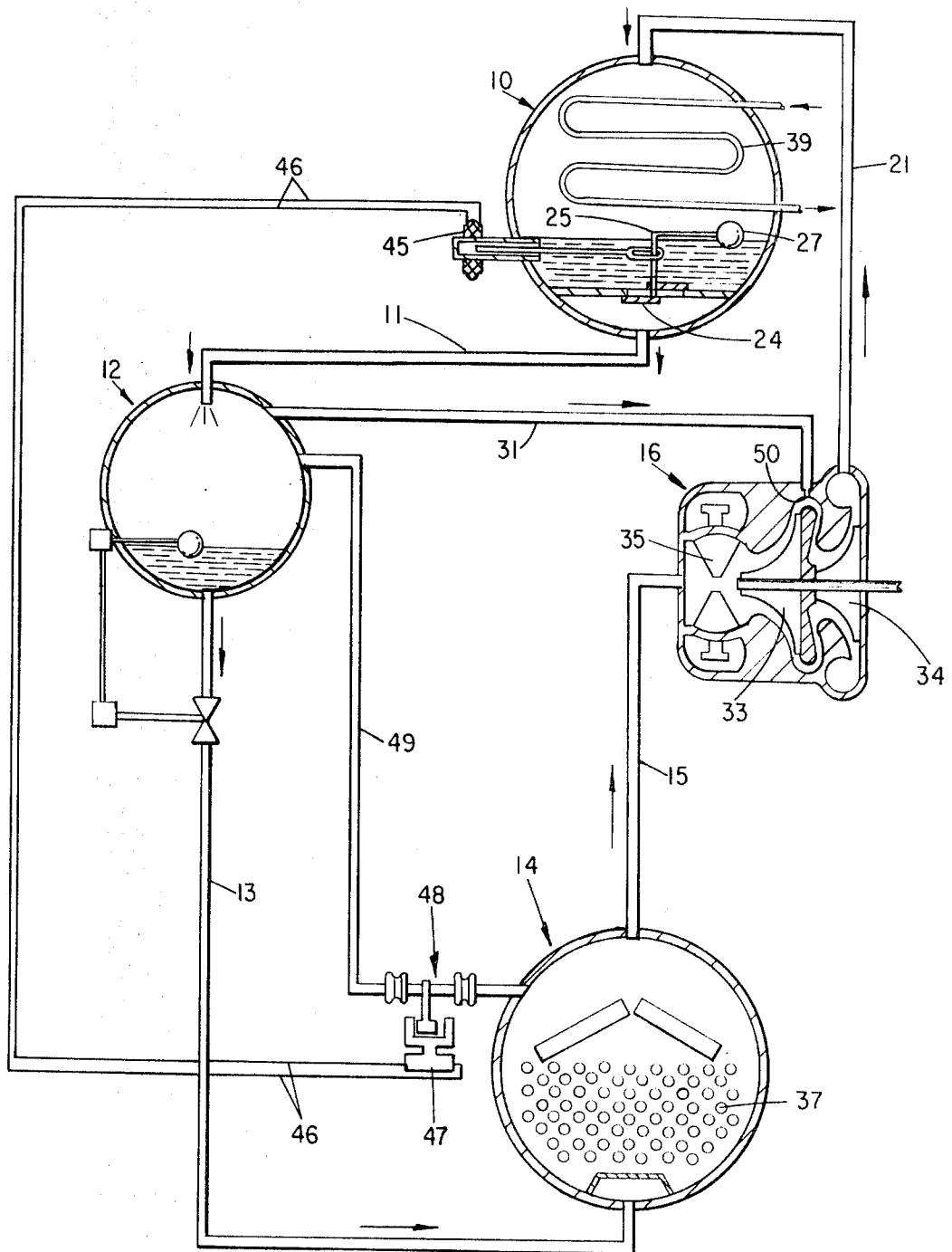
Attorneys—Harry G. Martin, Jr. and J. Raymond Curtin

[54] REFRIGERANT FEED CONTROL FOR CENTRIFUGAL REFRIGERATION MACHINES 4 Claims, 1 Drawing Fig.

[52] U.S. Cl. 62/197,
 62/218, 62/278, 62/510, 62/Dig. 17
 [51] Int. Cl. F25b 41/00
 [50] Field of Search..... 62/196,
 197, 278, 209, 218, 510

ABSTRACT: In a refrigeration system including a centrifugal compressor, a condenser, an economizer, and a cooler, there is provided control means to establish a full-flow passage between the condenser and the economizer for transmitting liquid and gaseous refrigerant to the economizer to raise the pressure therein above the pressure in the cooler existing at startup under certain conditions and during certain part load conditions, thereby permitting refrigerant liquid to flow in a normal fashion through the system.





INVENTOR.
WILLIAM T. OSBORNE

BY

D. Emmett Thompson

ATTORNEY

REFRIGERANT FEED CONTROL FOR CENTRIFUGAL REFRIGERATION MACHINES

BACKGROUND OF THE INVENTION

This invention has to do with refrigeration apparatus embodying a centrifugal compressor, a condenser, an economizer, and a cooler. The compressor is equipped with the usual inlet guide vanes or throttling means at the inlet of the compressor operable to control the capacity of the machine.

Upon shutdown of apparatus of this type, the throttling means is moved to closed position. When the machine is started up, circumstances may be such that difficulty will be experienced in getting the machine into continuous operation. For example, the condenser cooling water may be at an unusually low temperature due to the cooling tower being subjected to a low ambient temperature. On the other hand, the chilled water in the air conditioning system may, on startup, be at a high temperature. Under these conditions, upon startup of the machine, the pressure in the cooler will exceed the pressure in the economizer with the result that there will be no refrigerant flow from the economizer to the cooler, and any refrigerant in the cooler is quickly boiled off, whereby the cooler boils dry and the unit cuts out due to excessively low suction pressure. This action may take place quickly following startup of the machine and within the time lag established for the opening of the guide vanes at the inlet of the compressor. This situation may also prevail at low or part load operation with low condensing water temperature.

This problem is to some extent solved by providing a butterfly valve or damper in the gas line extending from the economizer to the inlet of the second compressor stage. That valve is rigged to be modulated to closed position when a predetermined minimum pressure differential exists between the economizer and the evaporator. However, valves of that nature are expensive; they tend to be unreliable; and they are not readily serviceable.

SUMMARY OF THE INVENTION

A pressure differential actuator is connected to the economizer and the cooler. When the pressure in the cooler approaches or exceeds the pressure in the economizer, this actuator effects operation of a switch connected to the float-operated metering refrigerant valve for driving the valve to full open position regardless of the float actuator associated with the valve.

BRIEF DESCRIPTION OF THE DRAWING

The FIGURE is a schematic representation of refrigeration apparatus embodying my invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the FIGURE, the apparatus includes a condenser 10 connected by line 11 to an economizer 12. The economizer is connected by refrigerant line 13 to the cooler 14. The vapor space of the cooler 14 is connected by line 15 to the inlet side of the centrifugal compressor 16, the output of which is connected by line 21 to the condenser 10.

A metering valve 24 having an actuator 25 is operated by a float 27 in the condenser. The valve 24 and float 27 serve to maintain a liquid seal between the condenser and economizer as is conventional to prevent the passage of gaseous refrigerant through line 11 to the economizer.

The vapor space in the economizer 12 is connected by a line 31 to an intermediate pressure area of the compressor. As is well understood, the line 31 may be connected to the housing enclosing the motor operating the compressor to provide refrigerant for cooling the motor with a return line to the cooler 14. Also, if the compressor is a single-stage machine, the line 31 may be connected to the gas flow passage intermediate the intake end of the impeller and the periphery

thereof. In the form of the invention illustrated, the compressor is of the two-stage type having first and second stage impellers 33,34, the line 31 being connected to the flow passage intermediate the impellers whereby suction is provided by the second impeller 34 for reducing the pressure in the economizer 12 to effect partial evaporation of the refrigerant therein to the end of lowering the temperature thereof as is well understood in the art. The compressor is provided at the intake with throttling means as guide vanes 35.

At startup of the machine with the throttling means 35 closed, or with the throttling means closed at low or part load operation and with the economizer exposed to the inlet pressure at the intermediate pressure stage of the compressor, the economizer pressure will drop below the cooler pressure. This is particularly true if the machine is started up with warm chilled water in the tube bundle 37 of the cooler 14 and, also, with the presence of low temperature water in the condenser coil 39. Under these conditions, the pressure in the cooler 14 may well exceed the pressure in the economizer 12, with the result that no refrigerant can flow through line 13 to the cooler 14.

In normal operation, the guide vanes 35 are under the control of a temperature sensor associated with the output line of the tube bundle 37; and upon elevation of the temperature of the water in that line, the guide vanes are moved to open position to establish the full capacity of the machine. However, particularly at startup, there is a programmed time lag in the operation of the vanes 35. With no flow of refrigerant from the economizer to the cooler, any refrigerant remaining in the cooler is quickly vaporized under the conditions stated, with the result that the cooler boils dry and the unit cuts out from excessively low suction pressure.

By my invention, there is provided control means operable upon the pressure in the economizer becoming equal to or less than the pressure in the cooler 14 to provide a full-flow passage from the condenser 10 to the economizer 12. This full flow passage may be established by providing the valve 24 with an override actuator in the form of solenoid 45 which, when energized, will operate the valve 24 to full open position regardless of the position of the float 27. The override actuator 45 is connected by a line 46 to a switch 47. The switch 47 is operated by a pressure differential means 48 connected in a line 49 extending from the vapor area of the economizer 12 to the vapor area of the cooler 14. The pressure differential device 48 functions to energize the override actuator 45 of valve 24 when the pressure in the cooler approaches or exceeds that in the economizer, in which event the valve 24 is operated to full open position permitting liquid and gaseous refrigerant to pass into the economizer 12. Due to the impedance in line 31 and the restriction and choking effect of opening 50, the pressure in the economizer is raised above the pressure then existing in the cooler 14, whereby the refrigerant in the economizer 12 flows to the cooler 14.

I claim:

1. Refrigeration apparatus comprising a compressor, a condenser, an economizer, and a cooler, a line extending from said condenser to said economizer, metering valve means in said line operable to meter the flow of liquid refrigerant from said condenser to said economizer, a line connecting said economizer to said cooler, and control means operable upon the pressure in said cooler approaching the pressure in said economizer to provide an open flow passage for transmission of refrigerant gas from said condenser to said economizer.

2. Refrigeration apparatus as set forth in claim 1 wherein said control means is operable independently of said metering valve means.

3. Refrigeration apparatus as set forth in claim 1 wherein said control means includes an override actuator operable upon the pressure in said cooler approaching the pressure in said economizer to move said metering valve to open position.

4. Refrigeration apparatus as set forth in claim 1 wherein said metering valve means consists of a float-operated valve, said control means includes a solenoid connected to said valve

and operable upon energization to move said valve to open position independently of said float, an energizing circuit for said solenoid including a normally open switch and switch ac-

tuating means operable upon the pressure in said cooler approaching the pressure in said economizer to actuate said switch to energize said circuit.

5

10

15

20

25

30

35

40

45

50

55

60

65

70

75