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Ditzler

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[54] **REFRIGERATION APPARATUS WITH DEFROSTING SYSTEM**

[75] Inventor: **John L. Ditzler**, York, Pa.

[73] Assignee: **Borg-Warner Corporation**, Chicago, Ill.

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[51] **Int. Cl.** **F25b 47/00**

[58] **Field of Search** 62/81, 151, 277, 278, 510

[56] **References Cited**

UNITED STATES PATENTS

2,841,962	7/1958	Richards	62/278
3,184,926	5/1965	Blake	62/81
3,234,752	2/1966	Quick	62/278
3,234,753	2/1966	Quick	62/278

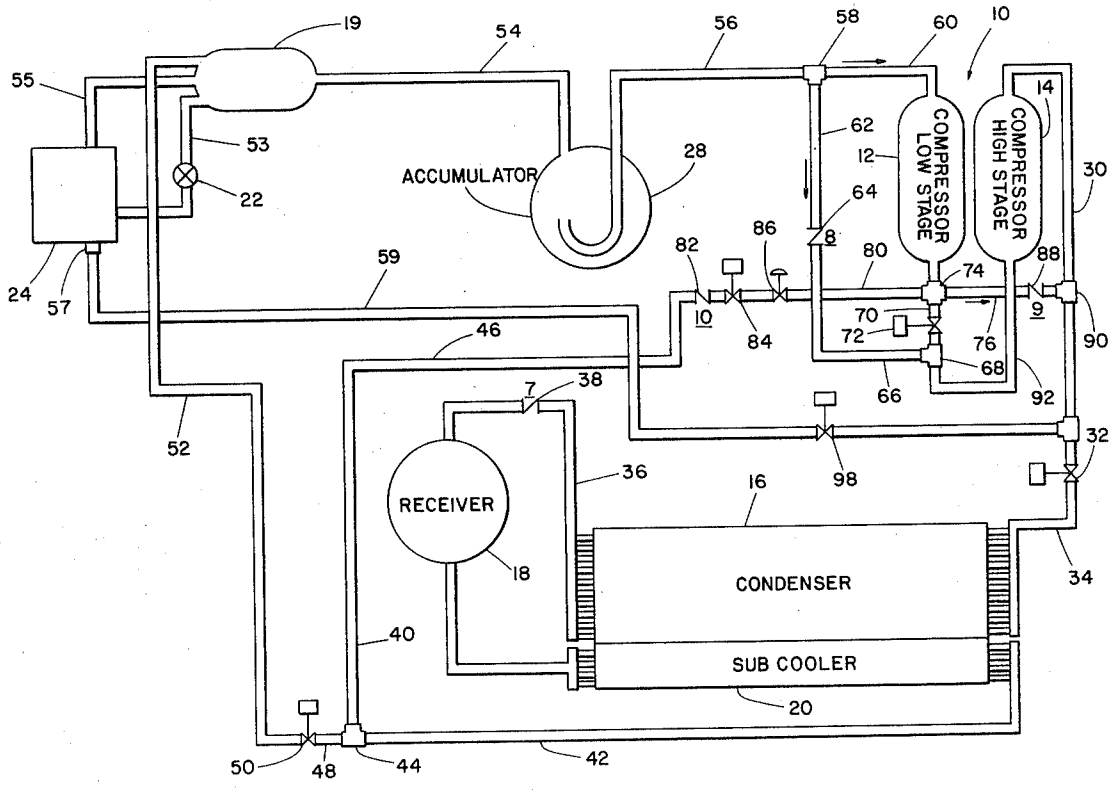
Primary Examiner—William J. Wye

Attorney, Agent, or Firm—Thomas B. Hunter

[57] **ABSTRACT**

An improved defrosting system for use with refrigeration apparatus, particularly of the type used for frozen food storage. The apparatus uses a two stage compressor with interstage cooling. During the defrost cycle, the suction gas from the evaporator coil is directed through the compressor so that the operation is in parallel, with a portion of the gas being admitted to the suction side of both the high stage and the low stage of the compressor. This permits an increased volume of hot gas at a higher temperature to be supplied to the evaporator and greatly reduces the time required to defrost the coil.

1 Claim, 1 Drawing Figure



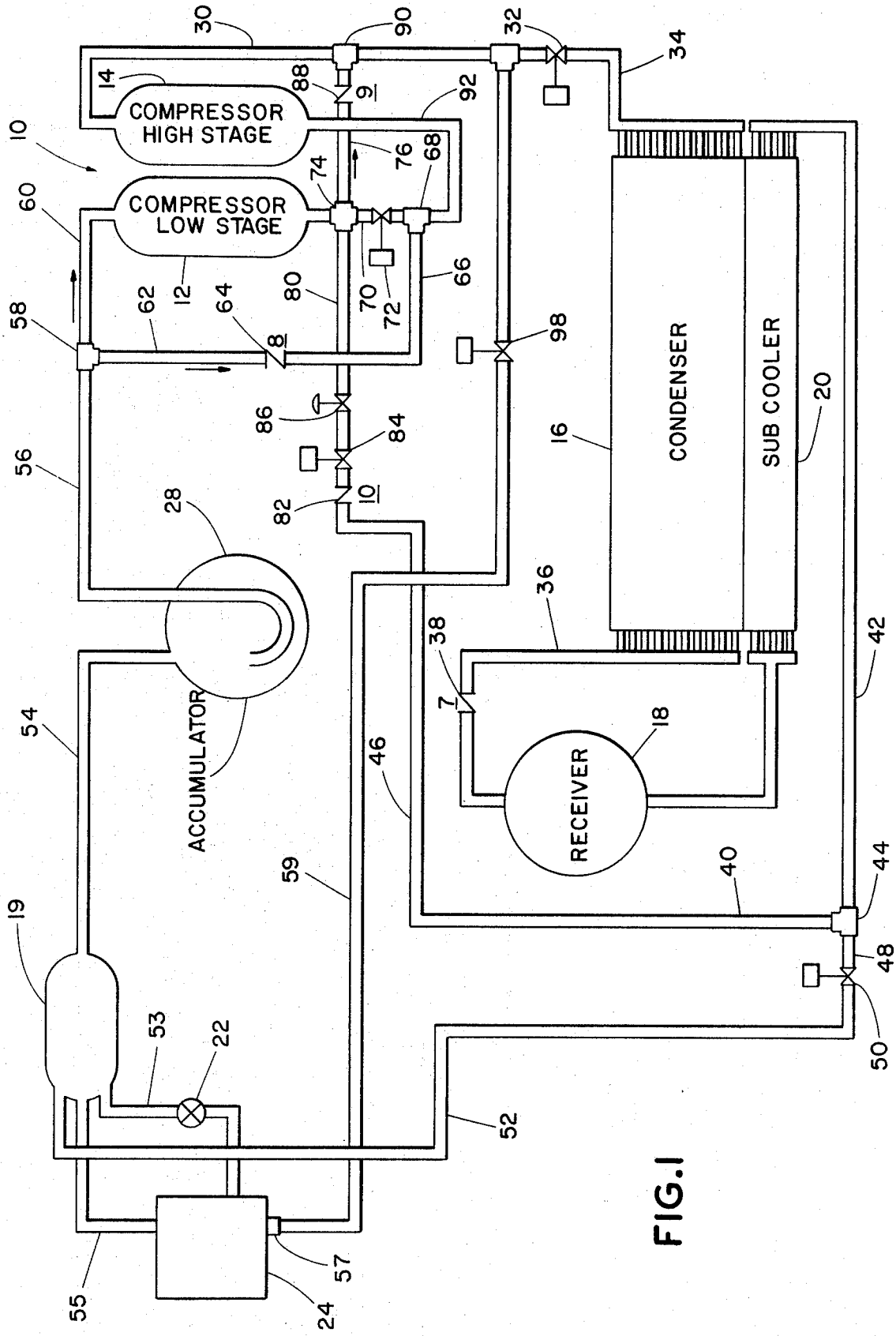

COMPRESSOR HIGH STAGE
COMPRESSOR LOW STAGE
CONDENSER
SUB COOLER
RECEIVER
ACCUMULATOR
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16
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19
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22
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92
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FIG. 1

REFRIGERATION APPARATUS WITH DEFROSTING SYSTEM

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates generally to defrosting arrangements for refrigeration apparatus used in frozen food storage or cold room applications. In the past, it has been conventional to employ a two stage compressor to permit operation to −30°F without exceeding safe operating temperatures when condensing with ambient air as high as 145°F. The use of a two stage compressor, in combination with interstage cooling, reduces the discharge gas temperature without sacrificing performance.

Several problems have been involved with the use of two stage compressors in accordance with the foregoing system. For example, since the temperature of the discharge gas is reduced the heat available for hot gas defrosting is limited. In the present invention, it is proposed to convert the compressor operation from two stage, series flow, wherein discharge gas from the low stage, after cooling, is admitted to the suction side of the high stage portion of the compressor, to parallel operation in which suction gas is admitted to the suction side of both the high stage and the low stage. Appropriate piping and valving arrangements are described, including control systems.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE is a schematic diagrammatic representation of a refrigeration apparatus constructed in accordance with the principles of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the FIGURE, reference numeral **10** designates a compressor having a low stage **12** and a high stage **14.** In normal operation, discharge gas from the compressor flows to condenser **16,** receiver **18,** and subcooler **20** to a flow-retarding unit **19** of the type described in U.S. Pat. No. 3,163,998. From unit **19** refrigerant flows to an expansion device **22** and the liquid refrigerant is then expanded into the evaporator **24,** flowing back to the compressor through an accumulator **28.**

With respect to the piping arrangement, line **30** connects the discharge side of the high stage **14** to a solenoid valve **32.** Line **34** continues the hot gas line leading from solenoid **32** to the inlet side of air cooled condenser **16.** The condensed refrigerant then flows through line **36,** check valve **38** to receiver **18.** Line **40** connects the receiver to the inlet side of the subcooler **20,** which usually forms the lower section of the condenser. From the subcooler **20,** the liquid refrigerant flows through line **40** to a "T" fitting **44** which provides a branch line **46** for interstage cooling, in a manner to be described below, and a branch line **48** passing through solenoid valve **50** to the liquid refrigerant line **52** on the inlet side of unit **19** and then through expansion device **22** to the evaporator **24.** The suction gas from the evaporator **24** flows through line **54** to the accumulator and from the accumulator through line **56** to a second T fitting **58.** One branch line **60** from T **58** flows to the suction side of the low stage **12;** and the other branch line **62** is connected to a one-way valve **64,** line **66,** to a T **68.** Line **70** leads from the discharge side of low stage **12** to a cross-flow fitting **74** which

joins the low stage discharge with interstage cooling line **80.** Line **80** contains a one-way valve **82,** connected to line **46,** solenoid valve **84** and expansion valve **86.** The expanded refrigerant mixes with the hot discharge gas from the low stage at fitting **74** and may be directed through line **76** and one-way valve **88** or continue through line **70,** through valve **72** to a T fitting **68** and high stage suction line **92.**

OPERATION

Under normal operation solenoid valves **72, 84, 32** and **50** are open; and valve **98** is closed. Accordingly, suction gas from the evaporator flows through line **54** through the accumulator **28.** From the accumulator, the gas flows through lines **56** and **60** to the low stage of the compressor. With valve **72** open, hot gas then flows through lines **70** and **92** to the inlet side of the high stage compressor, and then through line **30,** solenoid valve **32,** and line **34** to the condenser **16.** The liquid refrigerant leaves the condenser and flows through line **36,** one-way valve **38,** receiver **18** and line **40** the subcooler **20.** The subcooled refrigerant then flows through line **42** and is split into two streams, one flowing through line **46,** one-way valve **82,** solenoid **84** and expansion device **86** to mix with the gas leaving the low stage through line **70** at cross-flow connection **74.** The other stream flows through line **48,** solenoid **50** and liquid line **52** to the flow retarding unit **19.**

Since unit **19** is described in considerable detail in the previously noted U.S. Pat. No. 3,163,998 it is not necessary to repeat such description, which is incorporated herein by reference. It is understood that such unit, which is optional in the present invention, permits the controlled flow of liquid refrigerant, condensed in the evaporator during defrosting, back to the compressor. Line **52** connects to a heat exchanger (not shown) in unit **19** and passes liquid through line **53** to expansion valve **22.** Suction gas flows into unit **19** through line **55** and out through line **54.** The defrost hot gas connection is shown at **57.**

When on defrost solenoid valves **72, 84, 32** and **50** are closed; and valve **98** is open. In this case, the gas leaving the accumulator through line **56** splits into two streams: one at **60** flowing to the low stage suction and the other at **62,** flowing through one-way valve **64** and joining line **92** at T fitting **68.** From the low stage, the gas passes directly through line **76** through one-way valve **88** to fitting **90** where it joins line **30.** At the same time the high stage takes refrigerant gas through line **92** and directs it into line **30** where it eventually mixes with the discharge from the low stage. The gas then passes through open solenoid valve **98** and line **59** where it is directed to the hot gas connection **57** at unit **19.** The hot gas is then quickly effective to melt the frost on the coil returning to the compressor through the main suction line **54.**

While this invention has been described in connection with a certain specific embodiment thereof, it is to be understood that this is by way of illustration and not by way of limitation; and the scope of the appended claims should be construed as broadly as the prior art will permit.

What is claimed is:

1. A refrigeration system comprising: a compressor, a condenser, an expansion device and an evaporator all connected in closed-circuit, refrigerant flow relationship, said compressor having a low stage and a high

stage; means for conducting refrigerant from said low stage to said high stage in series flow during refrigeration operation; a hot gas defrost line connecting said compressor to said evaporator; a hot gas line connecting said high stage to said condenser; a suction gas line connecting said evaporator and said low stage; an interstage gas line connecting said low stage and said high stage; a valve in said interstage gas line; a branch line connecting said evaporator and said high stage, whereby upon closing of said valve, suction gas will flow through said low stage and said high stage in parallel; and means for cooling gas flowing through said interstage gas line.

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