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PLURAL STAGE REFRIGERATING APPARATUS

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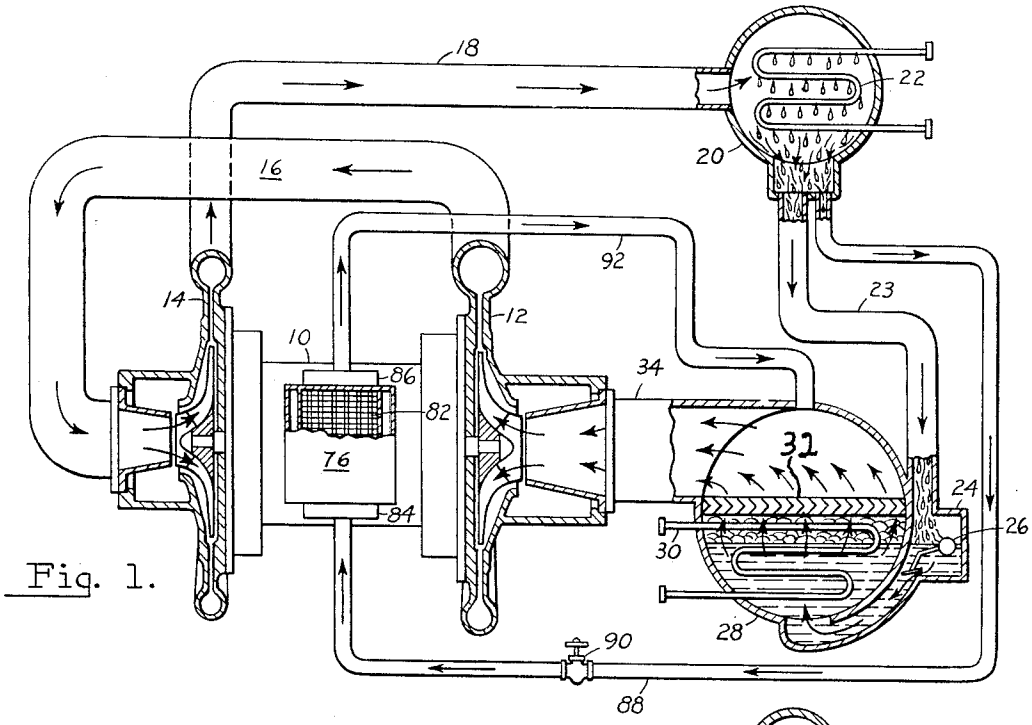


Fig. 1.

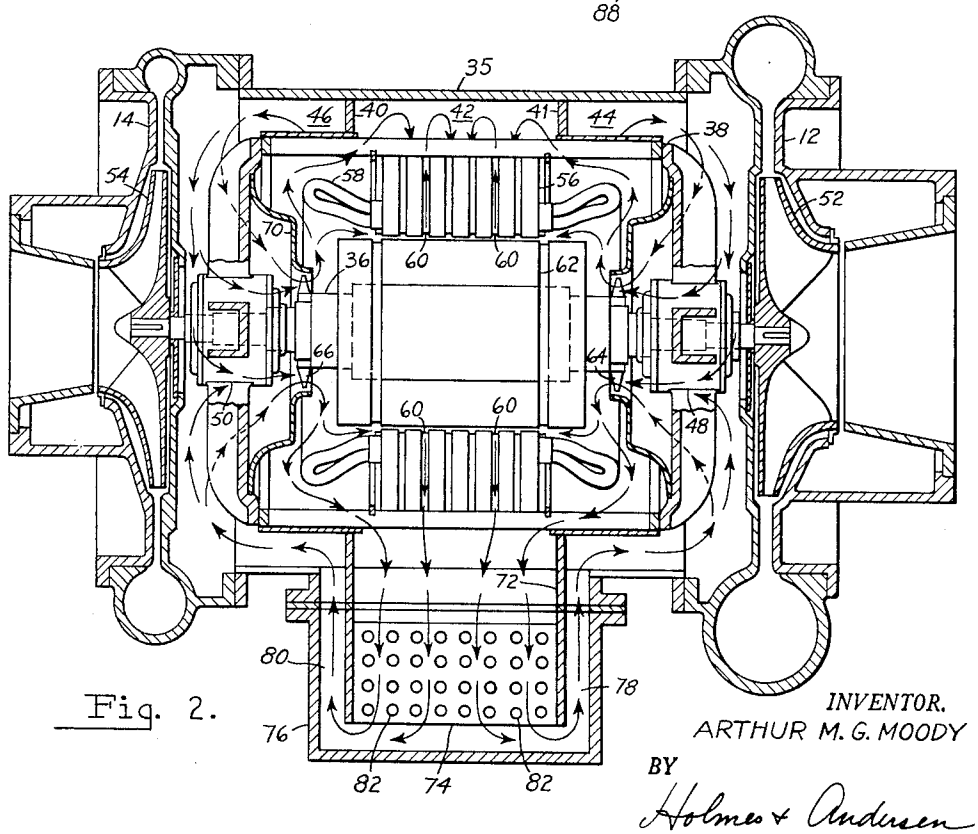


Fig. 2.

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PLURAL STAGE REFRIGERATING APPARATUS

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3 Claims. (Cl. 62—117.6)

This invention relates to refrigerating apparatus of the type including a motor-compressor assembly, and particularly to apparatus in which the motor and compressor are housed in a sealed unit.

It is an object of this invention to provide means for cooling the motor using the refrigerant of the apparatus as a heat exchange medium.

It is another object of the invention to provide fans on the motor shaft for causing a circulation of refrigerant gas in a closed circuit over the heat producing elements of the motor to cool said elements, then through a heat exchanger to remove heat from the gas.

It is another object of the invention to provide passageways in the motor casing to conduct refrigerant gas in two streams to the ends of the motor to flow first over the bearings and with each stream then separating into two streams one of which flows over the stator winding and the other of which flows through the gap and outwardly through passageways in the stator.

Other objects and advantages of the invention will appear as the specification proceeds to describe the invention with reference to the accompanying drawings, in which—

Figure 1 is a partly diagrammatic view of the refrigeration apparatus of my invention.

Figure 2 is a cross-sectional view of the motor-compressor assembly taken on an axial plane.

Referring now to Figure 1, an electric motor **10** has at one end a first compressor stage **12** and at the other end a second compressor stage **14**. A cross-over pipe **16** conducts gas from the discharge of the first stage **12** to the inlet of the second stage **14**. The gas discharged from the second stage **14** flows through a pipe **18** to a condenser **20**. The condenser **20** may be of the shell-and-tube type in which cooling water flows through the tubing **22** and the refrigerant is in the shell outside the tubes. Refrigerant liquid condensed in condenser **20** flows by gravity through pipe **23** to a float chamber **24**. Float **26** in float chamber **24** opens and closes to control the flow of refrigerant liquid to an evaporator **28** which is also of the shell-and-tube type in which the secondary refrigerant liquid such as water or brine flows through the tubing **30** and the refrigerant is in the shell outside the tubing **30**. The secondary refrigerant liquid circulates between the evaporator **28** and the cooling load served by the refrigeration apparatus to transfer heat from the load to the evaporator **28**. In removing heat from the secondary refrigerant, the refrigerant in the evaporator **28** boils forming gas which passes through the liquid eliminator **32** and thence into the suction pipe **34** to the inlet of the first stage compressor **12**.

The motor **10** has a fluid tight casing **35** secured in fluid tight relationship to compressor housings **12** and **14**. A motor frame **38** is supported in said fluid tight casing **35** by a pair of rings **40** and **41** which divide the annular space between motor frame **38** and said fluid tight casing into a central chamber **42** and end chambers **44** and **46**. Motor frame **38** has bearings **48** and **50** which rotatably

support a shaft **36**. Shaft **36** extends at one end into compressor housing **12** and has impeller **52** secured thereto. Although the shaft **36** makes a close fit with compressor housings **12** and **14**, small amounts of gas pass through such seals and the motor casing therefore contains the same refrigerant gas as the remainder of the apparatus. The other end of shaft **36** extends into housing **14** and has impeller **54** secured thereto. A stator **56** is secured to the motor frame **36**. Stator **56** has the usual windings **58**. A plurality of radial passageways **60** extend through the stator **56**. A rotor **62** is mounted on shaft **36** to rotate therewith. Rotor **62** rotates within stator **56** and has an outside diameter slightly less than the inside diameter of the stator **56** to provide a gap between the rotor **62** and stator **56**. Fans **64** and **66** are mounted on shaft **36** to rotate therewith. Shrouds **68** and **70** direct the gas into the fans **64** and **66**. A duct **72** has a heat exchanger **74** mounted therein. Duct **72** is connected to receive gas from central chamber **42**. A housing **76** surrounds duct **72** and provides passageways **78** and **80** in communication with duct **72** for the gas leaving the heat exchanger **74** to flow to the end chambers **44** and **46** respectively. Heat exchanger **74** has tubes **82** for conducting fluid from a supply header **84** to a discharge header **86**. Supply header **84** is connected by pipe **88** to condenser **20** to receive liquid refrigerant from condenser **20**. A valve **90** is interposed in pipe **88** to control the flow of liquid therethrough. If desired valve **90** may be of the thermostatic type in which a temperature sensing bulb is mounted in the gas stream leaving the discharge header **86**. Discharge header **86** is connected by pipe **92** to the evaporator **28**. The liquid refrigerant flowing upwardly in tubes **82** receives heat from the gas flowing over the outside surface of the tubes and is evaporated. The evaporated refrigerant gas flows to the evaporator **28** through pipe **92**.

The gas flowing over the tubes **82** of the heat exchanger **74** is cooled and flows through passageways **78** and **80** to end chambers **44** and **46**. From end chambers **44** and **46** the gas flows over the bearings **48** and **50** removing heat therefrom. The gas then flows through the fans **64** and **66**. The gas leaving each fan divides into two streams. One stream flows over the windings **58** to remove heat therefrom and it then flows into the central chamber **42**. The other stream flows into the gap between the stator **56** and rotor **62** and thence outwardly through passageways **60** into the central chamber **42**. In passing through the gap and the passageways **60** the gas removes heat from both the rotor and the stator. The gas collected in central chamber flows again through the heat exchanger **74** which removes heat from the gas prior to its recirculation through the motor.

It is thus seen that the heat is effectively transferred from the areas in the motor at which it is generated to the refrigeration system served by the compressor.

While the apparatus disclosed and described herein constitutes a preferred form of the invention, yet it will be understood that the apparatus is capable of alteration without departing from the scope or spirit of the invention, and that all modifications that fall within the scope of the appended claims are intended to be included herein.

Having thus fully described by invention, what I claim as new and desire to secure by Letters Patent is:

1. In refrigerating apparatus, the combination of an evaporator for vaporizing refrigerant, a condenser for liquefying refrigerant, a compressor for circulating refrigerant through said evaporator and said condenser, a motor for driving said compressor, a fluid tight casing enclosing said motor and compressor, a shaft and rotor assembly rotatably mounted in said motor, a heat exchanger in said fluid tight casing, a fan secured to said

shaft and rotor assembly for circulating refrigerant gas from said motor through said heat exchanger and back to said motor, said heat exchanger having fluid passageways, a first conduit between said condenser and said fluid passageways for conducting liquid refrigerant from said condenser to said fluid passageways and a second conduit between said fluid passageways and said evaporator for conducting refrigerant gas from said fluid passageways to said evaporator.

2. In refrigerating apparatus, the combination of an evaporator for vaporizing refrigerant, a condenser for liquefying refrigerant, a centrifugal compressor for circulating refrigerant through said evaporator and said condenser, a casing in fluid tight connection with said centrifugal compressor, a motor frame in said casing and spaced with respect to said casing, partitions between said motor frame and said casing dividing the space therebetween into a central chamber and two end chambers, a stator secured to said frame and having radial passageways therein communicating with said central chamber, bearings secured to each end of the frame, a shaft and rotor assembly rotatably mounted in said bearings, said shaft and rotor assembly extending into said compressor, an impeller in said centrifugal compressor, said impeller being secured to said shaft and rotor assembly, fan means secured to said shaft and rotor assembly for moving gas from said end chambers into said radial passageways and thence into said central chamber, a duct extending from said central chamber to said end chambers for conducting gas from said central chamber to said end chambers, a heat exchanger in said duct, fluid passageways in said heat exchanger, a first conduit between said condenser and said fluid passageways for conducting liquid refrigerant from said condenser to said fluid passageways and a second conduit between said fluid passageways and said evaporator for conducting refrigerant gas from said fluid passageways to said evaporator.

3. In refrigerating apparatus, the combination of an evaporator for vaporizing refrigerant, a condenser for liquefying refrigerant, a centrifugal compressor having an inlet connected to receive refrigerant from said evaporator and a discharge chamber connected to transmit refrigerant to said condenser, a substantially annular motor casing secured in fluid tight engagement with said compressor, a motor frame in said substantially annular motor casing, annular rings between said motor frame and said motor casing to support said motor frame in said motor casing, said annular rings being arranged to divide the annular space between said motor frame and said motor casing into a central chamber and two end chambers, a stator mounted in said motor frame opposite said central chamber, said stator having radial passageways communicating with said central chamber bearings in each end of the motor frame, a shaft and rotor assembly rotatably mounted in said bearings, said shaft and rotor assembly extending into said compressor, an impeller in said centrifugal compressor, said impeller being secured to said shaft and motor assembly, fans secured to said shaft and rotor assembly for moving the refrigerant gas from said end chambers through the gap between said stator and rotor and outwardly through the radial passageways of said stator into the central chamber, a duct extending from said central chamber to said end chambers for conducting gas from said central chamber to said end chambers, a heat exchanger in said duct, said heat exchanger having first fluid passageways through which the gas flows in moving from said central chamber to said end chambers, said heat exchanger having second fluid passageways, a first conduit between said condenser and said second fluid passageways for conducting refrigerant liquid from said condenser to said second fluid passageways and a second conduit between said second fluid passageways and said evaporator for conducting refrigerant gas from said fluid passageways to said evaporator.

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