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Jacobs

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[54] **COMBINATION COMPRESSOR-CONDENSER**

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[52] **U.S. Cl.**..... **62/507,** 62/513, 415/178

[51] **Int. Cl.**..... **F25b 39/04**

[58] **Field of Search**..... 415/177, 178; 62/498, 499, 507, 513

[56] **References Cited**

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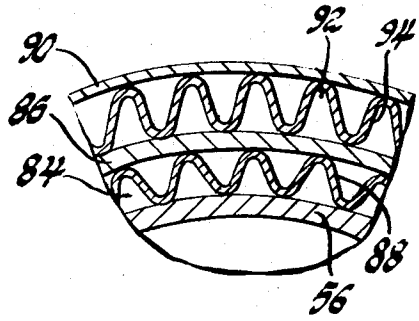
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[57] **ABSTRACT**

A combination compressor and condenser assembly for an automobile air conditioning system which has a cylindrical compressor housing with a drive shaft extending axially from the end of the housing. An annular member is connected at its opposite edges to the housing and forms a condenser cavity between the cylindrical housing and the member for cooling refrigerant which is discharged from the compressor through a port in the housing. An air shroud encircles the annular member to form an air passage adjacent the condenser cavity and conducts a flow of air discharged from an integral pulley-fan assembly which is connected to the compressor's drive shaft.

3 Claims, 3 Drawing Figures



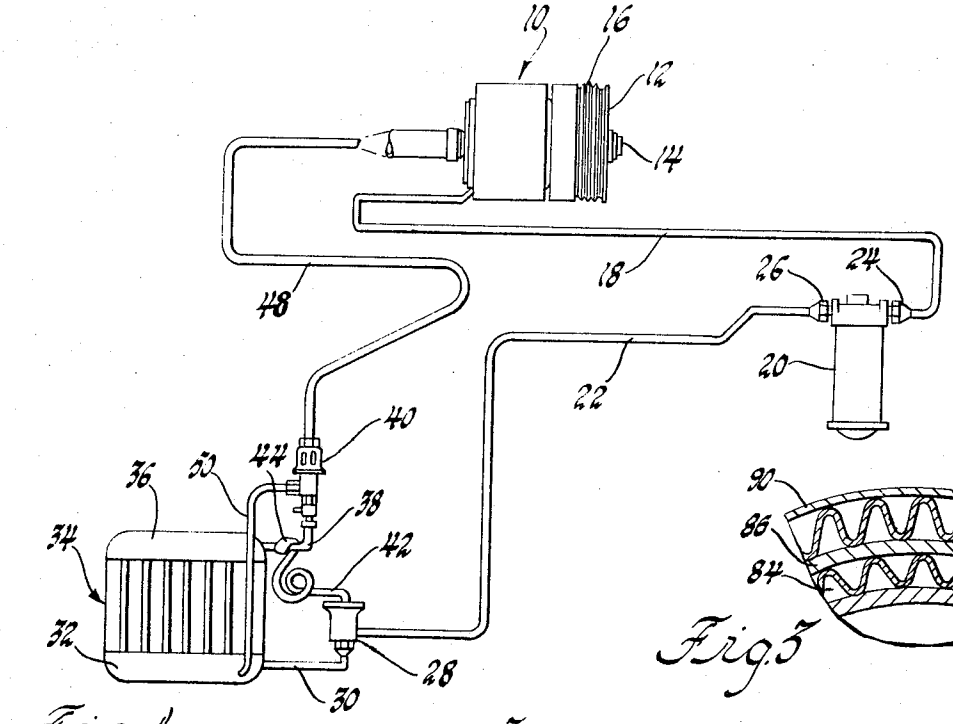


Fig. 1

Fig. 3

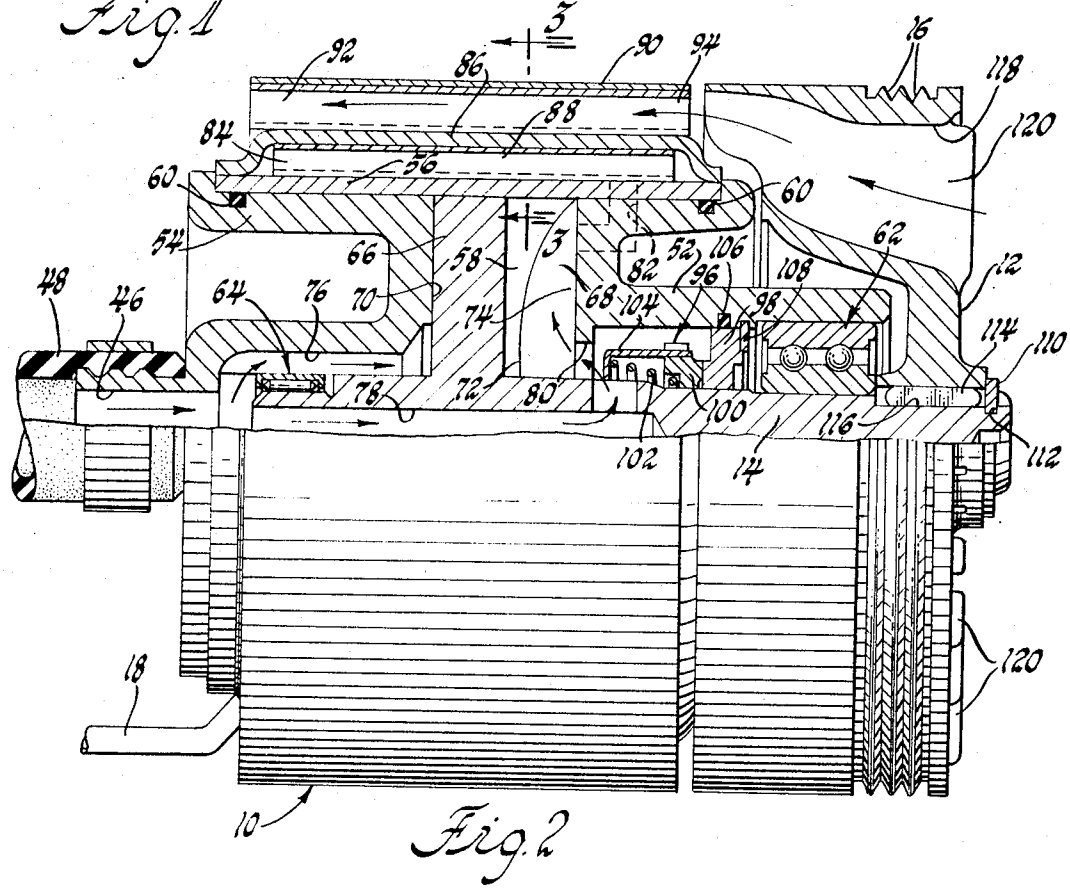


Fig. 2

COMBINATION COMPRESSOR-CONDENSER

This invention relates to automobile air conditioning systems and particularly to a combination compressor and condenser assembly for such systems.

The rapid increase in the number of components or accessories in the engine compartment of an automobile and the resultant decrease in available space has increased the desirability of combining related components into a compact assembly. Such a combination assembly is compact and often more economical than separate components. In addition, connections between the formerly separate components can often be simplified or eliminated.

Presently, in automobile air conditioning, a refrigerant compressor and condenser are separate components which are connected by refrigerant hoses. The condenser is normally located adjacent the cooling system radiator. This can have an undesirable effect on the cooling capacity of the radiator.

The present combined compressor and condenser assembly eliminates the separate condenser in front of the radiator and provides adequate condensing of refrigerant in adjacent annular passages encircling the compressor housing. The innermost annular passage is filled with hot refrigerant from the compressor while the outer passage passes cooling air over the wall between the two passages. An integral pulley-fan assembly drives the compressor and also passes air through the outer passage for cooling the refrigerant.

Therefore, an object of the present invention is to provide a compact and simple combination compressor and condenser assembly.

A further object of the invention is to provide a combination compresssor and condenser assembly with an adjacent refrigerant passage and air passage around the compressor housing and a pulley-fan assembly attached to the compressor's drive shaft for causing air to flow through the air passage for cooling refrigerant.

Further objects and advantages of the present invention will be readily apparent from the following detailed description, reference being had to the accompanying drawing in which a preferred embodiment is clearly shown.

In the drawing:

FIG. 1 is a schematic illustration of an automobile air conditioning system including the combination compressor-condenser assembly; and

FIG. 2 is a partially sectioned view of the compressor-condenser assembly; and

FIG. 3 is a sectioned view taken along section line 3—3 in FIG. 2 and looking in the direction of the arrows.

In FIG. 1 of the drawings, a compressor-condenser assembly **10** is illustrated. In assembly **10**, refrigerant is pressurized, then cooled and liquefied. The compressor is driven by a pulley-fan member **12** which is connected to a shaft **14** of the compressor. A plurality of grooves **16** in the circumferential surface of the pulley-fan member **12** are adapted to engage drive belts (not shown) which extend around the power shaft of an internal combustion engine. The pressurized liquid refrigerant flows out from the compressor-condenser assembly **10** through a conduit **18** to a receiver-dryer assembly **20**. In assembly **20**, vaporous refrigerant is separated from liquid refrigerant which then flows into a conduit **22**. Fittings **24** and **26** sealingly connect the conduits **18** and **22** to the dryer-receiver **20**. Dessicant materials within the dryer-receiver remove any moisture entrained in the refrigerant.

The refrigerant flows in the conduit **22** to a thermal expansion valve **28** where it is expanded to a lower pressure. The low pressure refrigerant flows from the expansion valve **28** through a conduit **30** into the lower portion **32** of an evaporator **34**. In the evaporator **34**, the liquid refrigerant boils and is evaporated by the passage of relatively warm air through the evaporator prior to entering the auto passenger compartment. The refrigerant vapor moves to the upper portion **36** of the evaporator **34** and then is drawn through a conduit **38** to a suction throttling valve assembly **40**. From valve **40** to the refrigerant flows through a conduit **48** to the compressor inlet.

The quantity of refrigerant entering evaporator **34** is regulated by opening and closing a valve member within the expansion valve **28**. The valve member is moved in response to the pressure level in a refrigerant-filled capillary tube **42**. The end of the capillary tube **42** forms a thermal bulb **44** which is in good heat transfer contact with the outlet conduit **38**. When the temperature of refrigerant leaving the evaporator **34** increases, the corresponding pressure increase within the capillary tube **42** causes the expansion valve **28** to move to a more opened position to permit more liquid refrigerant into the evaporator and thus increase its capacity to cool. When the temperature of the refrigerant in the conduit **38** decreases, the expansion valve **28** closes to reduce the quantity of liquid refrigerant within evaporator **34**.

The suction throttling valve assembly **40** controls the discharge of refrigerant from the evaporator by restricting refrigerant flow to the compressor. The throttling valve **40** responds by closing to decreasing pressure within the evaporator **34** to restrict refrigerant flow from the evaporator. This prevents evaporator temperature from falling below 32°F. and keeps the evaporator from accumulating frost which would restrict air flow through the evaporator.

An oil-bleed line **50** connects the lower portion **32** of the evaporator to the suction line **48** for passing any lubricating oil which collects the lower portion **32** of the evaporator to the compressor.

The compressor-condenser assembly **10**, best shown in FIG. **2**, includes a housing formed by a forward end member **52**, a rear end member **54** and a cylindrical side member **56**. Members **52**, **54** and **56** enclose a cylindrical compression chamber **58**. Refrigerant leakage is prevented between members **52**, **54** and **56** by O-ring sealing means **60**. Drive shaft **14** is centrally supported by the members **52** and **54** and is rotatable within a ball bearing assembly **62** at the forward end and a needle bearing assembly **64** at the rearward end of the compressor. Drive shaft **14** has a radially outwardly extending rotor portion **66** adapted to rotate within the compression chamber **58**. The internal faces **68** and **70** of members **52** and **54** respectively are nonplanar and curved in a sinusoidal shape to produce both a high area **72** and a low area **74** on the members **52** and **54**. The rotor **66** is slotted in an axial direction to receive vanes (not visible in FIG. 2) which reciprocate axially as they rotate with the rotor **66** and move along the end faces **68** and **70** of members **52** and **54**.

Refrigerant enters the compressor through an inlet **46** in rear member **54** and then passes through a passage **76** or through a central passage **78** in shaft **14**. It

then flows into the compression chamber **58** through a port **80** located at the low areas **74** on the members **52** and **54**. After compression, the refrigerant flows through outlet **82** into a condenser cavity **84** formed around the member **56** by an annular band **86**. The opposite edges of the band **86** are attached to member **56** by brazing or welding to form the sealed annular condenser cavity **84**. Corrugated fins **88** may be placed within the cavity **84** to increase heat transfer as is illustrated in FIGS. **2** and **3**. A cylindrical air shroud **90** encircles the band **86** to form an annular air passage **92** adjacent the cavity **84**. Corrugated fins **94** may be placed in the air passage **92** to increase the transfer of heat from refrigerant in cavity **84** through the wall **86** to air flowing through the passage **92**. The refrigerant from the compressor is pumped into condenser cavity **84** where it is cooled and liquefied by this heat transfer. From the condenser cavity **84**, the liquefied and cooled refrigerant passes into conduit **18**.

Refrigerant leakage from the compressor is prevented by a seal assembly **96** surrounding the shaft **14**. Seal assembly **96** includes a stationary member **98** and a rotatable member **100** both of which encircle shaft **14**. They are pressed in an axial direction against each other by a spring **102** to form a seal. A clip **104** supports one end of the spring **102**. An O-ring **106** prevents fluid leakage between the member **98** and the member **52**. An expandable retaining ring **108** holds the seal assembly **96** to end member **52**.

The shaft **14** is rotated by belts which engage grooves **16** in the pulley-fan assembly **12**. The belts also engage the power shaft of the auto engine. The pulley **12** is attached to shaft **14** by a retaining ring **110** which engages a groove **112** in the end of the shaft. A key **114** in a keyway **116** prohibits relative rotation between pulley **12** and shaft **14**. The pulley is of generally cylindrical shape and has air inlet passages **118** extending generally in an axial direction through the pulley fan **12**. The air passages **118** are spaced around the axis of the pulley-fan assembly **12** and are separated one from another by wall portions or blades **120**. These blades **120** may be helical with respect to the axis of the compressor or extend only in an axial direction. Air flows from the front of the pulley-fan assembly through the passages **118** and through the air passage **92** formed by shroud **90**. Heat is transferred from the refrigerant within the condenser cavity **84** through band member **86** to the air by fins **88** and **94**.

While the embodiment illustrated is a preferred embodiment, other embodiments may be adapted.

What is claimed is as follows:

1. An integral compressor and condenser assembly for automobile air conditioning systems comprising: a drive shaft mounted centrally in a compressor housing; compressing means within said housing operably connected to said shaft for pressurizing refrigerant when said shaft is rotated; an annular band member spaced radially outward from said compressor housing and joined along its opposite edges to said housing which forms a condenser cavity therebetween for cooling refrigerant discharged from said compressor means; a discharge port extending through the compressor housing and into said condenser cavity to pass relatively warm refrigerant into said condenser cavity; a cylindrical shroud member encircling said annular band member forming an axially extending air passage which is separated from refrigerant within said compressor cavity by said annular band member whereby air passing through said air passage absorbs heat from refrigerant in said condenser cavity; a combination pulley-fan member attached to the end of said shaft which extends from said housing adapted to be rotated by the automobile engine; said pulley-fan member having air inlets in its front end which extend through the member in a substantially axial direction which are aligned with said annular air passage inside said shroud; said air inlets being circumferentially located and separated by radially directed wall portions of said pulley-fan member to cause air to be drawn into said air inlets and discharged between said shroud and said band member for cooling refrigerant in said adjacent condenser cavity.

2. An integral compressor and condenser assembly for an automobile air conditioning system comprising: a drive shaft mounted centrally in a compressor housing; compressing means within said housing operably connected to said shaft for pressurizing refrigerant as said shaft is rotated; an annular band member spaced radially outward from said compressor housing and joined along its opposite edges to said housing which forms a condenser cavity therebetween for cooling refrigerant discharged from said compressor means; a discharge port extending through the compressor housing and into said condenser cavity to pass relatively warm refrigerant into said condensing cavity; a cylindrical shroud member encircling said band member and forming an axially extendng air passage which is separated from refrigerant in said condenser cavity by said annular band member whereby air passing through said air passage absorbs heat from refrigerant in said condenser cavity; a corrugated fin-strip member within said condenser cavity for increasing the heat transferred from said refrigerant through said annular band member; a corrugated fin-strip member in said air passage between said band member and said air shroud for increasing the heat transferred from said band member to air in the air passage; a combination pulley-fan member attached to the end of said shaft which extends from said housing adapted to be rotated by the automobile engine; said pulley-fan member having air inlets in its front end which extend through the member in a substantially axial direction which are aligned with said annular air passage inside said shroud; said air inlets being circumferentially located and separated by radially directed wall portions of said pulley-fan member to cause air to be drawn into said air inlets and discharged between said shroud and said band member for cooling refrigerant in said adjacent condenser cavity.

3. An automotive air conditioning system comprising: an integral compressor-condenser assembly having a refrigerant inlet for introducing lower pressure refrigerant to the compressor and an outlet for discharging relatively higher pressure refrigerant; expansion means connected to said outlet for expanding refrigerant from a high pressure to a lower pressure; an evaporator fluidly connected to said expansion means and in contact with air flowing into the automobile passenger compartment for transmitting heat from the air to refrigerant in said evaporator whereby it is vaporized subsequent to returning to the compressor; said compressor-condenser assembly including a cylindrical compressor housing encircled by a radially outwardly spaced annular band member whose opposite edges are attached to said housing to form a compressor cavity therebetween; means fluidly connecting said compressor to the

compressor cavity for transmitting pressurized and warmed refrigerant; an annular air shroud encircling said band member and forming an air passage therebetween for passing air in heat transfer relationship with the annular band member whereby heat is transmitted from refrigerant in the compressor cavity to air in the air passage; a combination pulley-fan assembly rotatable with said compressor and having axially extending air inlets aligned with said air passage; said air inlets being circumferentially spaced and separated by radial wall portions to form fan blades to pass air into said air inlet and between said annular band member and said air shroud; corrugated fin-strips in said condenser cavity and in said air passage for efficiently transmitting heat from refrigerant through said annular band member to air in said air passage.

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