United States Patent

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[54] UNDER CHASSIS POWER TAKE-OFF DRIVEN COMPRESSOR SYSTEM

5 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **417/234**
[51] **Int. Cl.** **F02b 71/06**
[50] **Field of Search** ..... 230/56 (A), 56, 38, 39, 139, 158, 208, 211, 206, 207; 417/234

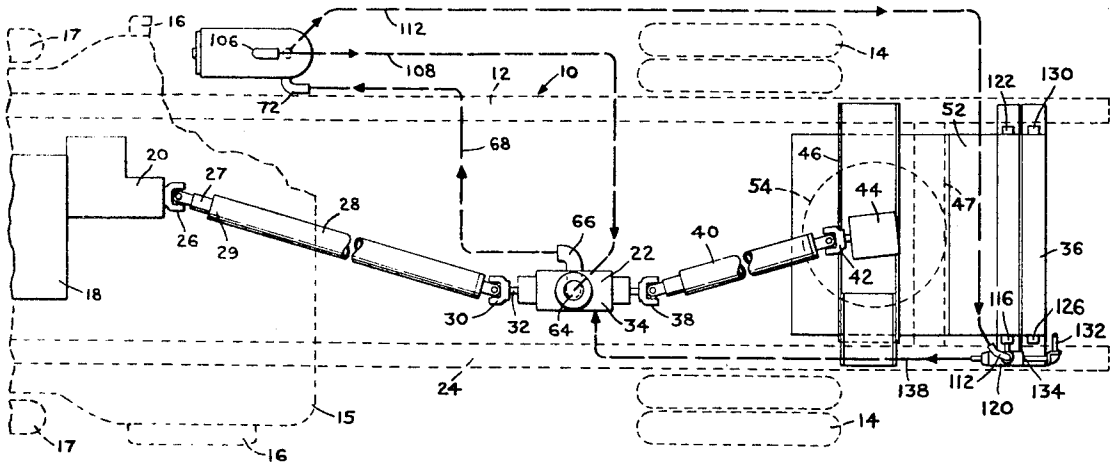
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1,255,632	2/1918	Poccia	230/56
1,439,628	12/1922	Kien	230/211X
1,693,183	11/1928	Rothmann	230/211

Primary Examiner—Robert M. Walker
Attorney—Daniel H. Bobis

ABSTRACT: A vehicle mounted compressor system driven by the vehicle engine. The compressor system has a separate cooling assembly driven directly by the compressor and independent of the cooling system for the vehicle engine.



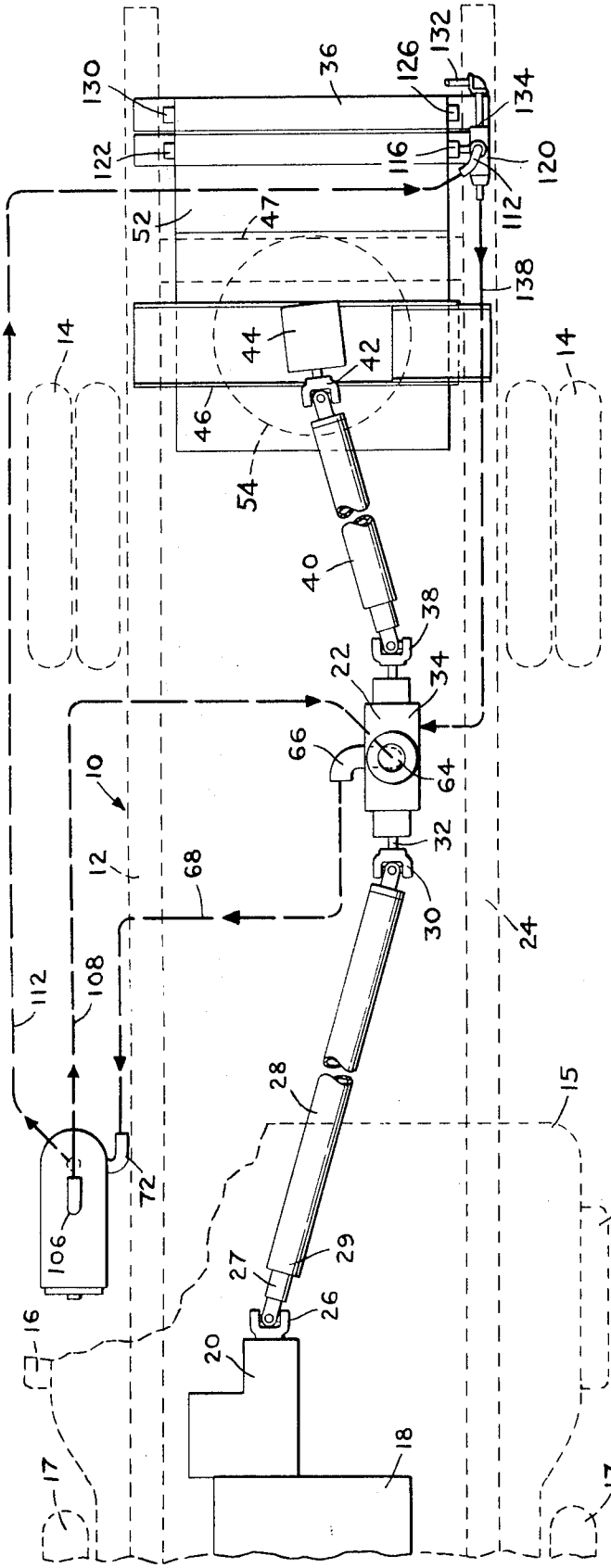


FIG. 1

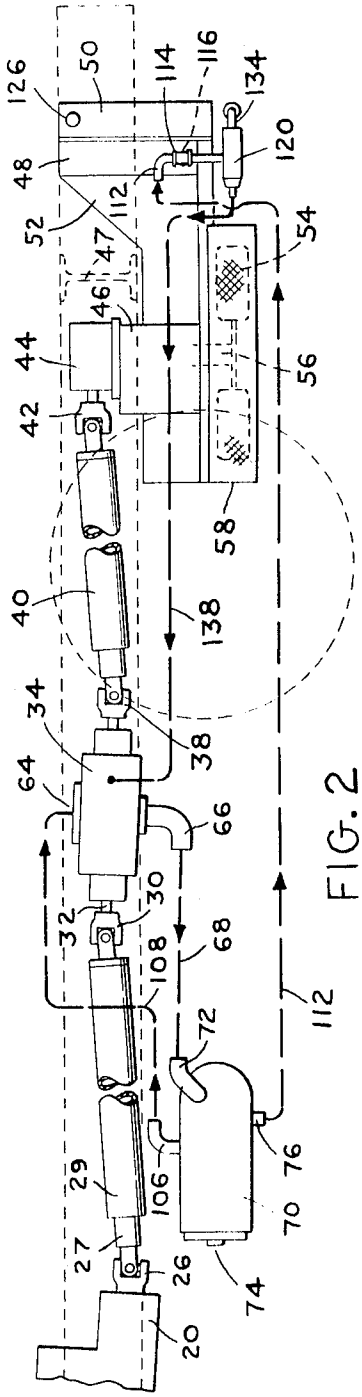


FIG. 2

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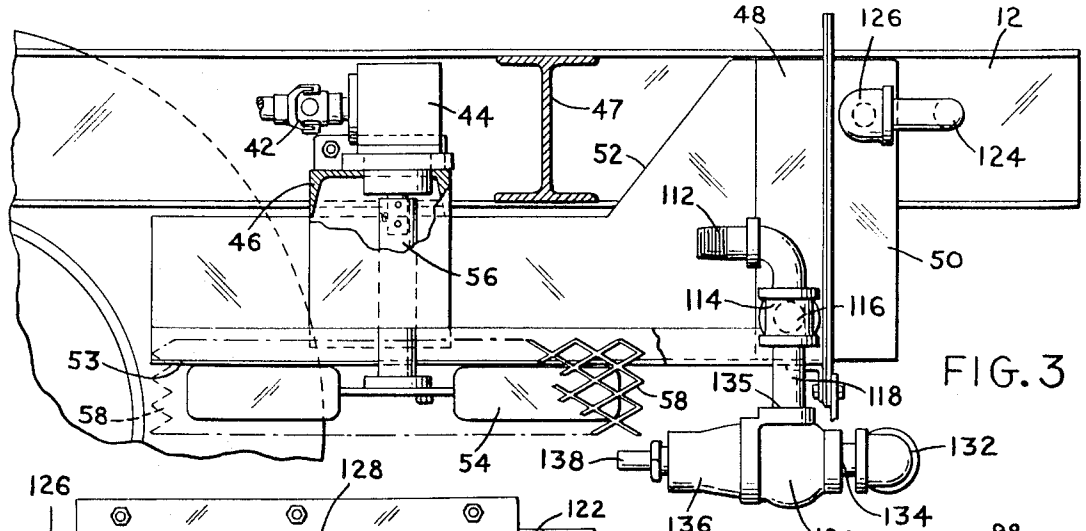


FIG. 3

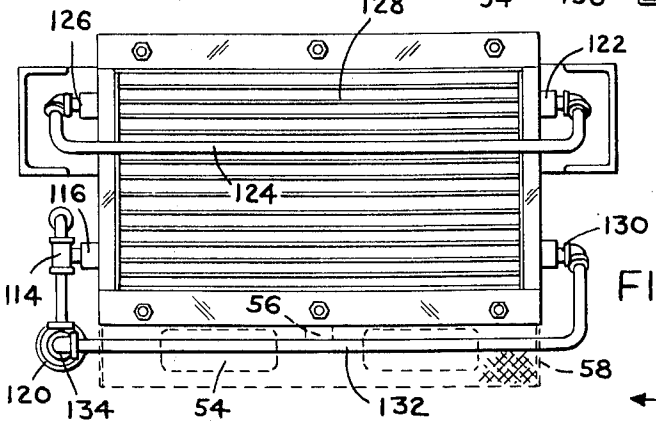


FIG. 4

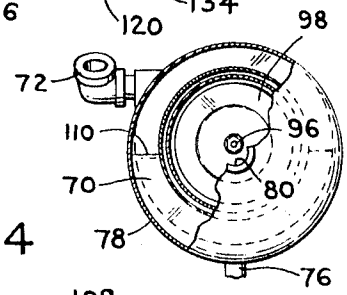


FIG. 6

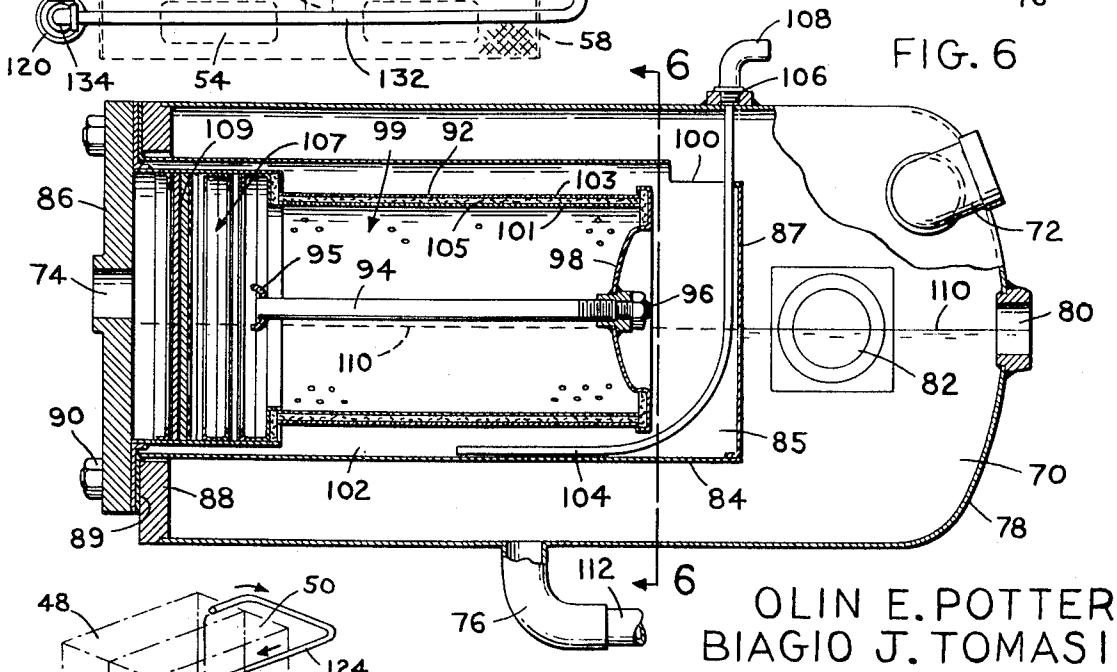


FIG. 5

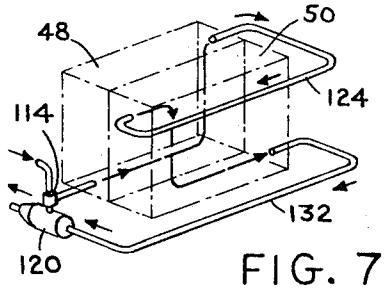


FIG. 7

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UNDER CHASSIS POWER TAKE-OFF DRIVEN COMPRESSOR SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a compressor assembly in which the assembly structure is modified to be attached to some part of a vehicle, wherein the actuation of the compressor assembly is effected through direct drive from the vehicle engine.

2. Description of the Prior Art

Compressor systems have often been mounted on motor vehicles and driven by the vehicle engine. However, these vehicle mounted compressor systems have presented problems which have reduced the usefulness of the vehicle or the compressor or both. Many of these problems relate to the cooling system for the compressor. A separate compressor cooling system is preferable to a dual purpose cooling system which cools both the vehicle engine and the compressor.

Such dual purpose cooling systems have proven to be relatively inefficient because of the several compromises which must be made in the design of the system to provide the extra cooling capacity to cool the compressor in addition to the vehicle engine.

An example of such a compromise is shown in U.S. Pat. No. 1,255,632 issued to L. Poccia on Feb. 5, 1918 in which a separate radiator member **41** for cooling compressor **30** is mounted and disposed behind radiator **13** for the vehicle engine **11**. However, the fan **14**, disposed between the two cores of the engine radiator must be oversized so that enough air will be drawn through radiator cores **13** to cool the engine without unduly raising the temperature of the cooling air, since the temperature of the air after passing through engine radiator **13** must be low enough and the quantity of air great enough to affect the required heat transfer to cool the compressor when the air subsequently passes through auxiliary radiator **41**.

Separate cooling systems for a vehicle mounted compressor include a separate radiator, fan and means to drive the fan. This equipment is usually bulky and complex and therefore prove to failure. Additionally, the mounting requirements to obtain efficient performance of the radiator and the fan drive often make it necessary to sacrifice valuable working space in the vehicle.

Accordingly, it is an object of the present invention to provide an improved vehicle mounted compressor assembly having a separate cooling system for the compressor.

Yet another object of the present invention is to provide an improved vehicle mounted compressor assembly having a separate cooling system for the compressor, which cooling system is driven through the compressor.

Still another object of the present invention is to provide an improved vehicle mounted compressor system which can be installed in a standard vehicle truck frame without excessive modification of the truck frame.

Yet another object of the present invention is to provide an improved vehicle mounted compressor assembly which can be mounted on the frame of a standard truck without using any of the available space above the truck chassis.

Still another object of the present invention is to provide a cooling system for a vehicle mounted compressor assembly having cooling cores arranged to provide counter current flow of the coolant therethrough.

Yet another object of the present invention is to provide an oil cooling assembly for a truck mounted compressor in which the fan for the oil cooling assembly rotates in a horizontal plane to produce minimum obstruction in the working area of the truck frame.

Still another object of the present invention is to provide a cooling assembly for a truck mounted compressor system with the cooling assembly having a horizontally disposed fan means driven through the compressor, which fan means can effect a horizontal flow of cooling air through the cooling cores.

Yet another object of the present invention is to provide an improved air receiver - oil separator tank for a vehicle mounted compressor system which receives an air oil mixture from the compressor discharge and separates the oil from the compressed air and separately stores the oil and the compressed air.

Still a further object of the present invention is to provide an air receiver - oil separator tank of reduced volume suitable for a vehicle mounted compressor system.

Yet another object of the present invention is an air oil separating and storage tank for a vehicle mounted compressor system in which the air oil separating element is disposed at least partially below the oil level in the tank.

SUMMARY OF THE INVENTION

The present invention sets forth a vehicle mounted compressor system having a double ended rotary-type compressor and a separate cooling system for the compressor mounted on the vehicle frame. The vehicle engine provides power for both the rotary-type compressor and the compressor cooling system by a series of drive shafts from the engine to the compressor and then from the compressor to the compressor cooling system. The components of the compressor system are designed to use a minimum of the normally usable space in vehicles. The oil and compressed air from the compressor discharge are separated and stored in a single horizontally disposed tank. The cooling system fan rotates in a horizontal plane to conserve space while the cooling cores are in a vertical plane to function at maximum efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic in plan view of the compressor system mounted on a truck frame.

FIG. **2** is a side view of FIG. **1**.

FIG. **3** is a side view in section of the oil cooling assembly.

FIG. **4** is a rear end view of the oil cooling assembly.

FIG. **5** is a side view in section of the receiver-demister tank assembly in the compressor system.

FIG. **6** is a rear end view partly in section of FIG. **5**.

FIG. **7** is a schematic representation of the flow path through the cooling unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGS. **1** and **2** show in phantom lines a standard industrial truck generally indicated at **10** having a commonly available ladder-type truck frame **12**, a standard rear wheel assembly **14**, the usual drivers compartment **15** and running boards **16** and front wheel assembly **17**. The engine of the truck **18** has a power takeoff connection **20** which drives a rotary compressor **22** by means of a commonly known automotive-type drive shaft assembly consisting of a splined drive shaft **28** having an externally splined section **27** axially slidably engaged with an internally splined hollow tubular section **29**, the drive shaft **28** being connected at one end to the power takeoff connection **20** by universal joint **26**, and at the other end connected to the rotor shaft **32** of compressor **22** by a power receiving universal joint **30**. The compressor **22** can be attached to the side rail **24** by any convenient method of attachment as for example by the use of a suitable bracket or fastening strap, not shown. The compressor rotor shaft **32** extends through the compressor housing **34** and drives the compressor cooler assembly generally indicated at **36** through a second automotive drive assembly consisting of a splined drive shaft **40** connected at one end to a right angle gear box **44** which provides power for the compressor cooler assembly.

The oil cooler assembly **36** is mounted from a cross brace **46** connected at each end to the side rails **24** of the truck ladder frame **12**. The cooler assembly consists of series-connected first and second cooling cores **48** and **50** respectively, and a horizontally disposed fan **54** driven by shaft **56** extending from right angle gear box **44**. A shroud member **52** is disposed about the first and second cooling cores and the fan **54**, with the fan rotating in a plane slightly below the bottom

53 of the shroud. The shape of the shroud 52 and the positioning of the fan 54 with respect to the shroud cause the fan when operating to draw air through the first and second cooling cores and exhaust the air downwardly towards the ground and radially outward. A shield 58 for the fan protects against accidental injury from the fan blades 54.

The compressor 22 has an inlet 64 and a discharge outlet 66 which is connected by suitable conduit means, designated by dashed lines 68, to the inlet 72 of an air receiver - oil separator tank 70. As shown in FIGS. 5 and 6 the air receiver - oil separator tank 70 consists of an outer housing 78 with the inlet 72 mounted in the upper portion thereof, a compressed air discharge outlet 74 in the removable cover 86 and an oil outlet 76 in the bottom of the outer housing. An oil filler neck (not shown) attaches to opening 80 at the end of the housing and a oil level gauge 82 is located in the side of the housing to indicate the oil level 110 in the tank. The majority of the oil in the compressor discharge is separated from the compressed air upon entry through inlet 72 into the outer housing and falls to the bottom of the outer housing usually rising to the level 110 as shown in FIG. 5. A closed oil tight chamber 84 partially submerged in the oil within the outer housing is formed from a cylindrical member 85, closed at one end by a wall 87 and with a flange portion 89 at the other end, which flange is secured between the end cover 86 for the outer housing 78 and a bolting flange 88 on the outer housing 78 to which the end cover is fastened by a plurality of bolts 90. An air-oil separating element 92 is mounted within oil tight chamber 84 by means of a mounting rod 94 extending from an anchoring member 95 axially through the separating element and secured by mounting bolt 96 which presses against retaining member 98. The air-oil separating element includes a first cylindrical section generally indicated at 99 having perforated inner and outer walls 101 and 103 respectively enclosing a filtering material 105. A second cylindrical section generally indicated at 107 contains a plurality of discs of filtering material generally indicated at 109 disposed perpendicularly to the axis of the air-oil separating element 92.

An opening 100 in the top of oiltight chamber 84 allows compressed gas from the compressor discharge in outer housing 78 to enter the closed oiltight chamber and then pass through the air-oil separator element 92 wherein any oil remaining in the compressed gas will be separated out. The separated oil falls to the bottom section 102 of the oiltight chamber where it is drawn off by means of a siphon tube 104 which extends from the bottom section 102 of the oiltight chamber through opening 100 and out an opening 106 in the outer housing 78. The oil then passes by means of conduit 108 to an area of lower pressure to be more fully explained below.

A conduit shown as a dotted line 112 connects oil outlet 76 of air receiver - oil separator tank 70 to the inlet of a T-fitting 114 having one outlet connected to the inlet 116 of the first cooling core 48 and the second outlet connected by conduit 118 to a thermostatic valve 120 whose function will be explained later. As seen in FIGS. 3, 4 and 7 the oil entering inlet 116 of first cooling core 48 passes through the core and exits from outlet 122 and then is carried by conduit 124 to the inlet 126 of the second cooling core 50. The oil passes through the coils 128 of core 50, exits through outlet 130 and then is carried by conduit 132 to the second inlet 134 of the thermostatic valve 120. The oil leaves thermostatic valve 120 passing from outlet 136 to conduit 138 which carries the oil back to compressor housing 34 where the oil is used to cool the compressor and provide sealing for operation of the compressor.

An alternate flow path for the oil in conduit 112 can be established by changing the setting of thermostatic valve 120. If this valve is set to allow communication between the first inlet 135 and the outlet 136, the oil will bypass the cooling cores 48 and 50 and flow directly back to the compressor.

Conduit 108 connects siphon tube 104 to the inlet of the compressor to provide the source of lower pressure in order to siphon off the scavenged oil in the bottom section 102 of the closed oiltight chamber.

OPERATION

The construction of the invention set forth herein provides for efficient operation of the entire compressor system. Power for the compressor 22 is obtained from the vehicle engine 18 through the power takeoff connection 20 on the engine and transmitted through the splined shaft 28 to the compressor rotor shaft 32. The rotary compressor shaft in turn provides power through splined shaft 40 to power the fan of the compressor cooler assembly. It should be apparent therefor that the fan of the compressor cooler assembly operates only when the rotary compressor is in operation. The compressor discharges through outlet 66 and conduit 68 into the inlet 72 of the air oil receiver - oil separator tank 70. Oil from the tank passes through conduit 112 to the T-fitting 114 which leads to either the inlet 116 of the first cooling core 48 or to the thermostatic valve 120.

If the coil is cold because the compressor has just started operation the thermostatic valve will position itself to communicate inlet 135 with outlet 136 thereby bypassing the cooling cores. As the compressor continues to operate the temperature of the oil rises and the thermostatic valve 120 will position itself to block off inlet 135 and to communicate inlet 134 with outlet 136 thereby establishing a flow path from the air receiver - oil separator tank 70 through the first and second cooling cores and then back to the compressor.

The oil cooling assembly is constructed to provide maximum efficiency. The first and second cooling cores are arranged in series to provide for a countercurrent flow through the cores thereby providing maximum cooling efficiency by maintaining, as near as possible a constant temperature difference between the temperature of the oil to be cooled in the cores and the cooling air passing through the coils. To be specific, the air entering the first cooling core 48 has already been heated as it passed through the second cooling coil 50 and this warmed air cools the uncooled oil coming directly from the air receiver - oil separator tank. Similarly, oil entering the second cooling core 50 has been partially cooled in the first cooling core and is further cooled by the unheated air which is being drawn from the atmosphere through the second cooling core. It should be mentioned, of course, that two cooling cores are not critical to the function of the compressor system. A cooling system using one or three cooling cores would also be operable.

The positioning of the fan 54 to rotate in the horizontal plane and outside shroud 52 provides several advantages. Of primary importance is a considerable saving of space. The fan can now be mounted below the frame of the truck and does not take up any useful working space on the truck frame. In order for the horizontal fan to effectively draw air through the vertical first and second cooling cores it is necessary to surround the entire compressor cooler assembled with shroud 52. The shroud changes the direction of the air flow produced by the fan from horizontal as it passes the cooling cores to vertically downward as it approaches the fan 54. Because the fan rotates in a plane below the shroud, it imparts a large radial velocity component to the air it exhausts, thereby preventing a strong exhaust downdraft. Such downdrafts are undesirable since they cause large amounts of dust to be raised when the compressor system is working in certain environments Additionally, by placing the cooling cores vertically between the rails 24 of the truck frame 12, the cores are provided maximum protection from damage due to road debris thrown up during over-the-road operation. Further, facing the cooling cores rearward prevents hot engine exhaust air from being drawn into the cooling cores by the fan, thereby eliminating the possible loss of cooling efficiency that would occur if the engine exhaust were drawn through the cooling cores.

Mention should be made of the advantages in construction of the air receiver - oil separator tank 70. Because the tank is of small diameter and mounted horizontally it can be easily positioned anywhere under the truck frame, for example under the running board 16 as shown in FIG. 1. However, because of the horizontal position and its small diameter the

oil level in the tank is higher than the lowest point of the air-oil separator element. For this reason, the air-oil separating element is placed within the oiltight container **84** within the tank and the inlet **100** to this oiltight container is at the top thereof to prevent any flow of accumulated oil into the oil separator filter element **92**. Since the pressure in the air receiver - oil separator tank **70** is approximately equal to the discharge pressure of the compressor any oil which has been separated by the oil separator element **92** and has accumulated in the bottom section of the oiltight chamber **84** can be easily removed by means of the siphon tube **104** which in turn is connected through conduit **108** to the inlet **64** of the compressor **22** where the oil is productively used.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown but that they may be widely modified within the invention defined by the claims.

We claim:

1. In a vehicle mounted compressor system driven by the vehicle engine the combination comprising:
- a power takeoff connection on said vehicle engine;
- a compressor mounted on said vehicle, said compressor having a housing with an inlet and a discharge and a shaft extending through said housing journaled to rotate therein;
- an oil system operatively associated with said compressor to collect and store oil from the discharge of the compressor and return said oil to said compressor;
- a compressor cooler assembly operatively associated with said oil system comprising:
  - cooling core means mounted to said vehicle at a position remote from both the compressor and the vehicle engine for effecting heat transfer between the oil and the ambient air;
  - first conduit means to carry oil to be cooled to said cooling core means;
  - second conduit means to carry cooled oil from said cooling core means;
  - fan means operatively associated with said cooling core means to provide air to cooling the oil ; and
  - shroud means disposed about said cooling core means and said fan means, said shroud means so constructed and arranged that actuation of said fan means effects airflow through said cooling core means;
- first drive means operatively connecting said fan means with one end of said compressor rotor; and
- second drive means operatively connecting said power takeoff connection with the other end of said compressor shaft to drive said compressor and thereby drive said fan means.

2. The combination claimed in claim **1** wherein said fan means are disposed at an angle generally perpendicular to said cooling core means.

3. The combination of claim **1** wherein:
- said cooling core means is composed of first and second cooling cores disposed one behind the other; and
- third conduit means connect the first cooling core to the second cooling core in counterflow, series relationship.

4. In a compressor system mounted to the frame of a vehicle and driven by the vehicle engine, the combination comprising:
- a power takeoff connection on said vehicle engine;
- a compressor mounted on said vehicle, said compressor having a housing with an inlet and discharge and a shaft extending through said housing journaled to rotate therein;
- an oil system operatively associated with said compressor to collect and store oil to said compressor;
- a compressor cooler assembly operatively associated with said oil system and mounted near the rear end of said vehicle frame comprising:
  - cooling core means disposed in a generally vertical position for effecting heat transfer between the oil and the ambient air;
  - fan means disposed generally in a horizontal plane and operatively associated with said cooling core means to provide air for cooling the oil; and
  - shroud means disposed about said cooling core means and said fan means, said shroud means so constructed and arranged that actuation of said fan means effects airflow through said cooling core means;
- first drive means operatively connecting said fan means with one end of said compressor rotor; and
- second drive means operatively connecting said power takeoff connection with the other end of said compressor shaft to drive said compressor and thereby drive said fan means.

5. In a compressor system mounted to the frame of a vehicle and driven by the vehicle engine, the combination comprising:
- a power takeoff connection on said vehicle engine;
- a compressor mounted on said vehicle, said compressor having a housing with an inlet and a discharge and a shaft extending through said housing journaled to rotate therein;
- an oil system operatively associated with said compressor to collect and store oil from the discharge of the compressor and return said oil to said compressor;
- a compressor cooler assembly operatively associated with said oil system comprising:
  - cooling core means for effecting heat transfer between the oil and the ambient air;
  - fan means operatively associated with the cooling core means and mounted to the frame at a suspended position from the frame and below the upper surfaces of the frame whereby the fan does not occupy useful working space above the frame; and
  - shroud means disposed about said cooling core means and said fan means, said shroud means so constructed and arranged that actuation of said fan means effects airflow through said cooling core means;
- first drive means operatively connecting said fan means with one end of said compressor rotor; and
- second drive means operatively connecting said power takeoff connection with the other end of said compressor shaft to drive said compressor and thereby said fan means.