Oct. 11, 1966 J. H. HEIDORN 3,278,110

COMPRESSOR

Original Filed July 15, 1959 4 Sheets-Sheet 1

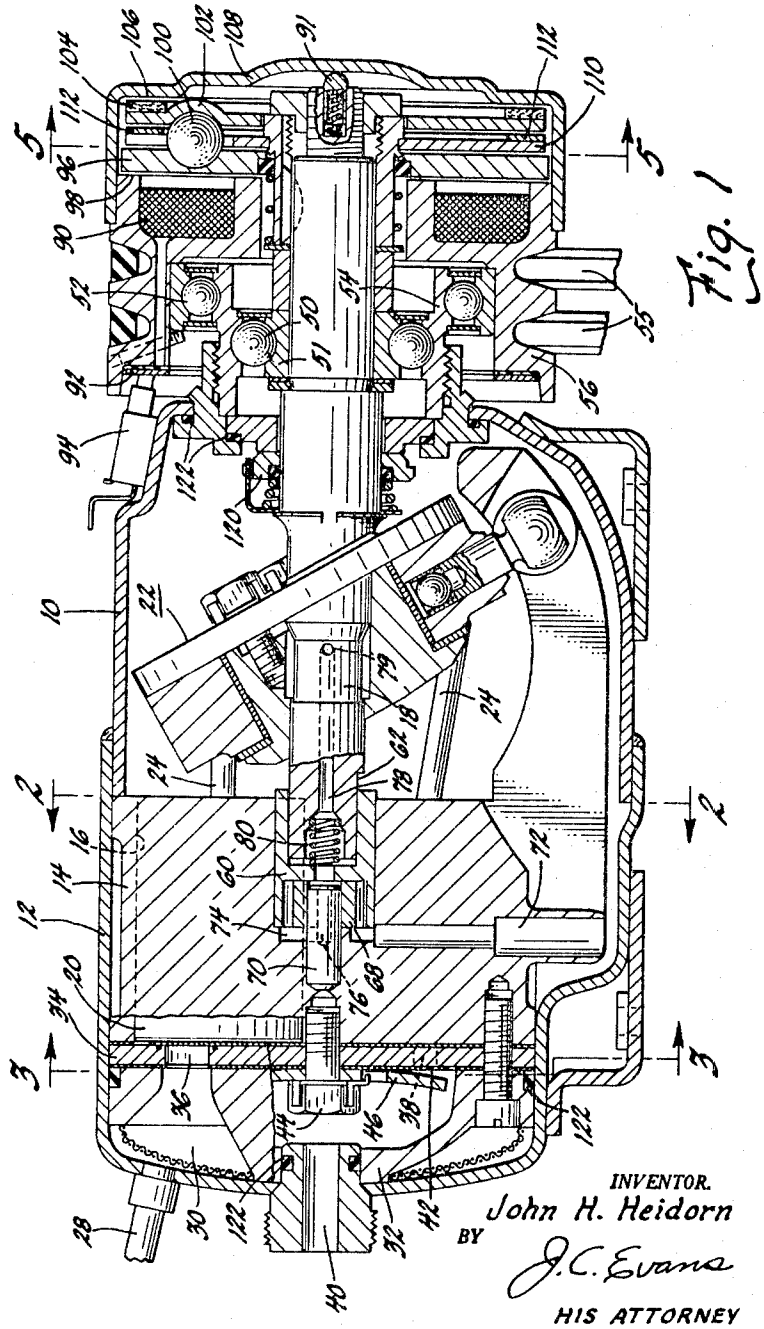


Fig. 1

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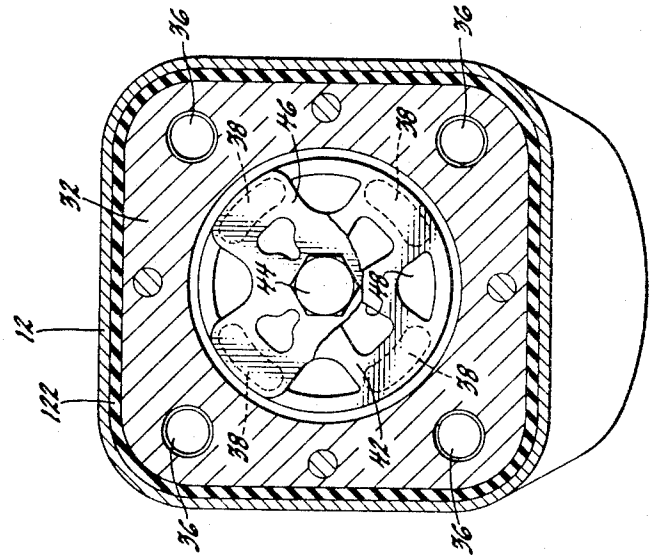


Fig. 3

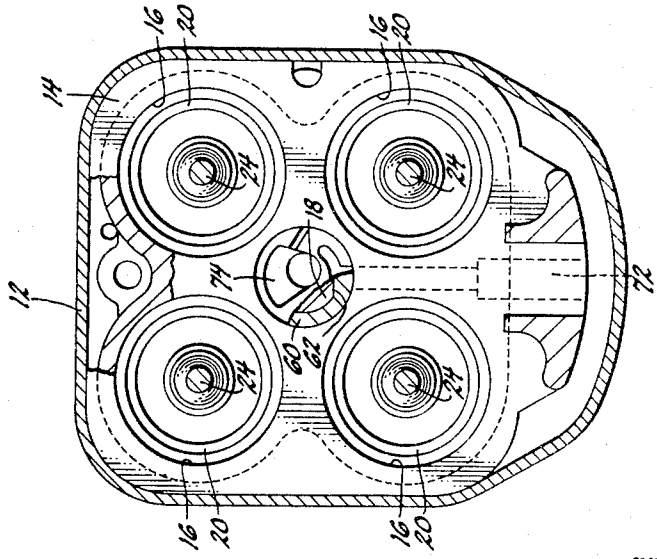


Fig. 2

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COMPRESSOR

Original Filed July 15, 1959 4 Sheets-Sheet 3

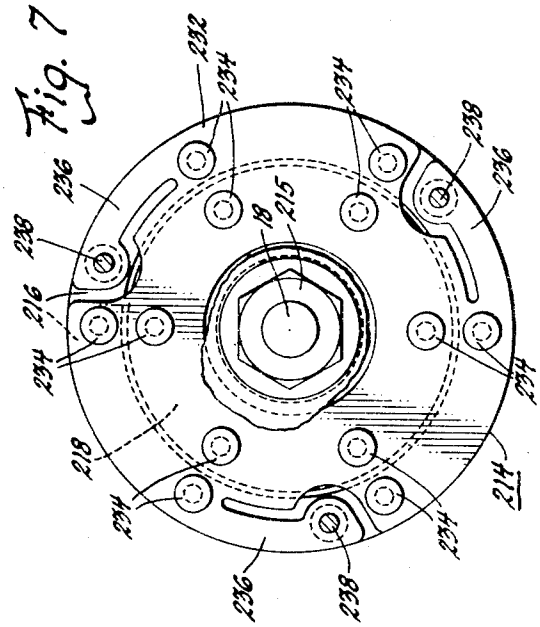


Fig. 7

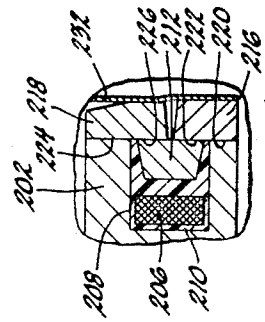


Fig. 9

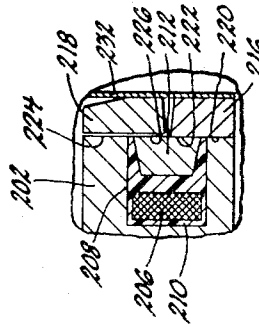


Fig. 8

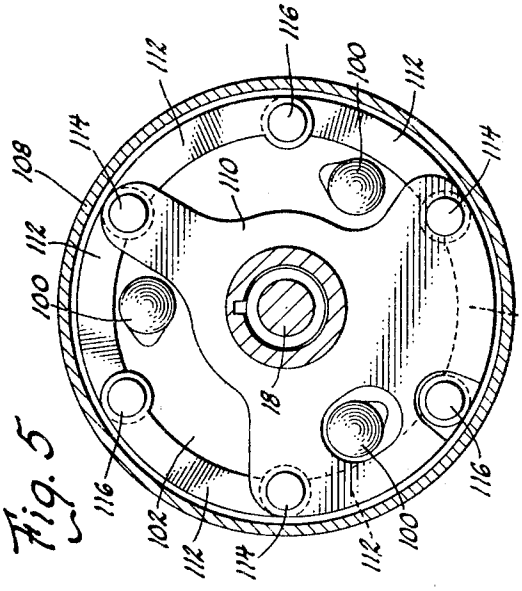


Fig. 5

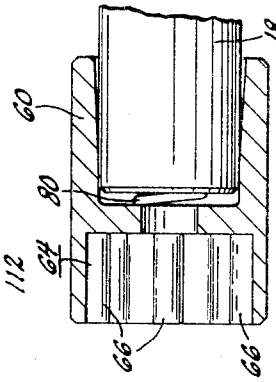


Fig. 4

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COMPRESSOR

Original Filed July 15, 1959 4 Sheets-Sheet 4

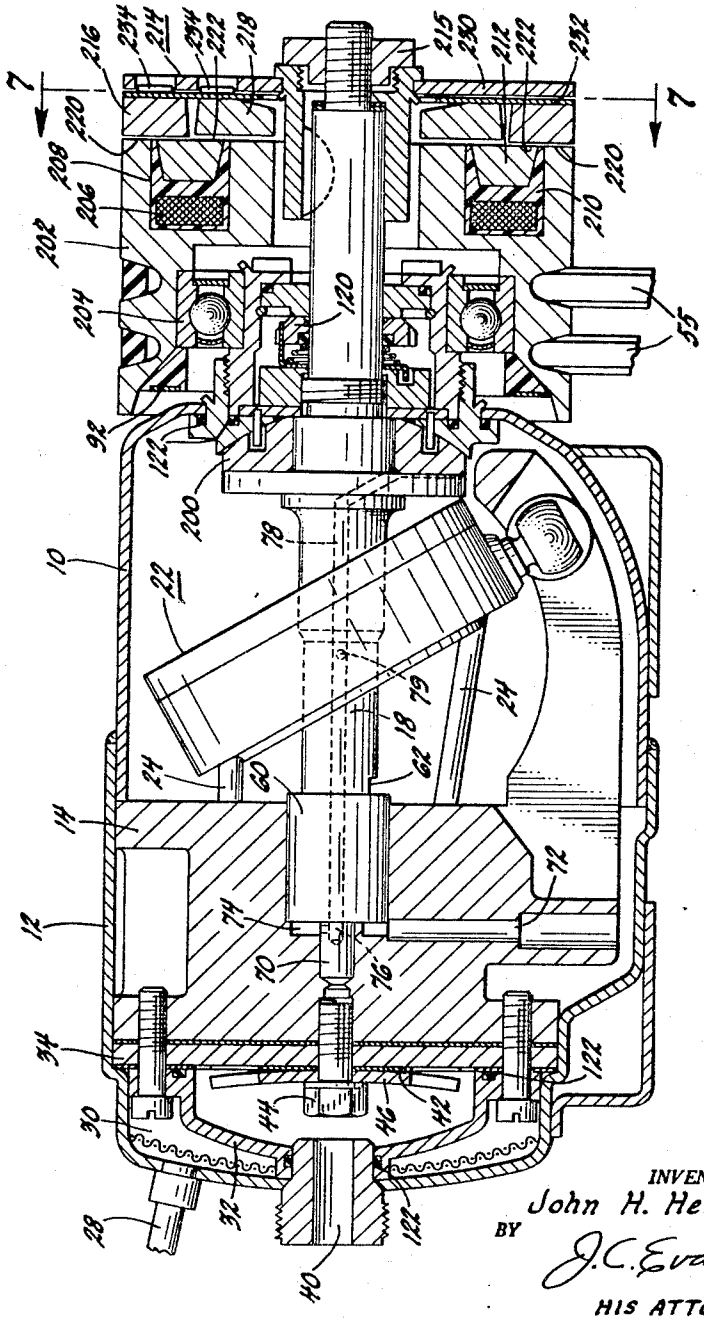


Fig. 6

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United States Patent Office 3,278,110 Patented Oct. 11, 1966

3,278,110
COMPRESSOR

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Application July 25, 1961, Ser. No. 126,683, now Patent No. 3,190,419, dated June 22, 1965, which is a division of application Ser. No. 827,346, July 15, 1959, now Patent No. 3,092,307, dated June 4, 1963. Divided and this application Oct. 19, 1964, Ser. No. 404,753
3 Claims. (Cl. 230—15)

This is a division of divisional application Serial No. 126,683, now Patent No. 3,190,419 issued June 22, 1965, filed July 25, 1961, which is a division of Serial No. 827,346, filed July 15, 1959, now Patent 3,092,307.

This invention relates to refrigerating apparatus and more particularly to a refrigerant compressor for use in automobile air conditioning systems and the like.

A large number of problems present themselves in designing refrigerant compressors of the type which are adapted to be driven by a car engine either continuously or intermittently through a clutch. These problems result from the fact that the compressor is required to operate throughout a very wide speed range wherein the speed of the compressor bears no relationship to the refrigeration requirements. The problems are multiplied by the fact that the amount of space available for the compressor is very limited and all of the parts must be of lightweight construction and arranged in a small casing.

It is an object of this invention to provide a compressor which is adapted to be driven from a car engine through an improved clutch arrangement.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a vertical sectional view showing a preferred form of the invention.

FIGURE 2 is a sectional view taken substantially on line 2—2 of FIGURE 1 with parts broken away.

FIGURE 3 is a sectional view taken substantially on line 3—3 of FIGURE 1 looking in the direction of the arrows

FIGURE 4 is a fragmentary sectional view showing the relationship of the oil pump housing to the drive shaft of the compressor.

FIGURE 5 is a sectional view taken on line 5—5 of FIGURE 1 and looking in the direction of the arrows.

FIGURE 6 is a sectional view showing a modified type of compressor.

FIGURE 7 is a sectional view taken substantially on line 7—7 of FIGURE 6 and looking in the direction of the arrows.

FIGURE 8 is a fragmentary sectional view showing the clutch in the early stages of engagement.

FIGURE 9 is a view similar to FIGURE 8 but showing the clutch fully engaged.

Referring now to FIGURE 1 of the drawings wherein a preferred embodiment of the invention has been shown, reference numerals **10** and **12** designate complementary cup-shaped casing elements which serve to enclose a multiple cylinder compressor. These casing elements are made of sheet metal and have their open ends arranged in telescoping relationship, as best shown in FIGURE 1.

The compressor consists of a cylinder block **14** which is supported within the casing element **12** and which is provided with four cylinder bores **16** which are symmetrically arranged about the main drive shaft **18**. By

virtue of using four cylinder bores arranged as shown, it is possible to utilize an outer casing which is substantially rectangular in cross section rather than using a cylindrical casing of the type most commonly used in automobile air conditioning compressors. This makes it possible to reduce the width and height of the compressor casing without reducing the capacity of the compressor.

Reciprocating piston elements **20** are disposed to operate within the bores **16** in accordance with conventional practice. These piston elements are driven by the wobble plate assembly **22** through the usual connecting rods **24**. The gas to be compressed enters through the usual suction line **28** which communicates with the low pressure suction chamber **30** formed in the cylinder head **32**. The usual valve plate **34** is disposed between the cylinder head **32** and the cylinder block **14** and is provided with the usual series of inlet and outlet ports **36** and **38**, respectively. The compressed gas leaves the compressor through the outlet passage **40**.

As best shown in FIGURES 1 and 3 of the drawings, the outlet valve reed **42** is circular in shape and has its center portion clamped firmly to the valve plate **34** by means of a cap screw **44**. The extent of opening of the reed valve **42** is limited by a rigid backup plate member **46**. The valve plate **42** is provided with cutaway portions **48** which render it more flexible and in effect divide the reed into four lobes which are tied together at their outer periphery. The backup plate **46**, as shown in FIGURE 3, is provided with lobes which overlie the outlet ports **38**. By constructing the reed valve in the form of a single platelike element, the severity of the opening and closing movement of the valve plate is reduced since the compressed gas flowing out of the one outlet port at a given time tends to retard the closing movement of the next preceding valve port and also tends to initiate the opening movement of the next succeeding valve port.

The main drive shaft **18** is supported for rotation within the casing section **10** by means of a first ball bearing assembly **50** in which the inner ball race **51** is secured to the shaft **18** and the outer ball race **54** is carried by the end wall of the casing **10**. This first ball bearing assembly serves to take up the end thrust resulting from the wobble plate pushing against the piston elements. A second ball bearing assembly **52** is provided as shown and serves to take up the belt load. This second ball bearing assembly is arranged directly in line with the belts **55** which drive the compressor pulley **56** secured to the outer ball race of the ball bearing assembly **52**. It will be noted that the bearing sleeve member **54** which forms the outer ball race for the bearing assembly **50** also forms the inner ball races of the ball bearing assembly **52** and is, in effect, an extension of the stationary housing element **10**. By virtue of this bearing arrangement, the ball bearings and the associated ball races stand up much longer in service than the prior art arrangements as the bearing assembly **52** takes the main belt load and the balls are always moving about in the races whenever the car engine operates.

The inner end of the drive shaft **18** is journaled in the cylinder block **14** in such a manner that slight misalignment between the casing sections **10** and **12** will not cause excessive strain or wear on the drive shaft **18**. As best shown in FIGURES 1 and 4 of the drawings, the inner end of the drive shaft extends into a tapered opening (shown somewhat exaggerated in FIGURE 4) in a member **60** which is adapted to rotate with the shaft **18**. As shown in FIGURE 2 of the drawings, the shaft **18** is provided with a flat portion **62** which cooperates with a flat portion on the member **60** so that the member **60** rotates with the shaft **18** but due to the taper on the

inner surface of the member **60**, the shaft **18** need not line up exactly with the opening in the member **60**.

The one end of the member **60** is provided with an oil pumping chamber **64**. The inner walls of the oil pumping chamber **64** are provided with conventional gear teeth projections **66** which cooperate with conventional oil pumping gear **68** rotatably supported on a fixed pin **70**. Thus, the gear element **68** is cooperation with the rotating member **60** serves to form a gear type oil pump which supplies oil under pressure to the various bearings requiring lubrication.

Referring now to FIGURE 1 of the drawings, the bottom portion of the compressor casing serves as an oil sump and oil from this sump is pumped upwardly through the oil passage **72** to the inlet side of the oil pump just described. The oil discharges from the pump into a chamber **74** which communicates with oil passage means **76** and **78** provided in the pin **70** and in the main shaft **18**. The oil is then fed through the radial passage **79** to the wobble plate bearings.

A coil spring **80** serves to bias the member **60** to the left as viewed in FIGURE 1. However, if the speed of the compressor should become great enough so that the quantity of oil handled by the pump exceeds the amount of oil which can flow through the oil feed passage **78**, the excessive oil pressure in the pumping chamber will cause the elements **60** and the oil pump gear **68** to move to the right, as viewed in FIGURE 1, so as to automatically unload the oil pump.

When no refrigeration is required, the compressor may be declutched from the car engine and the drive pulley **56** by means of the magnetic clutch shown in FIGURES 1 and 5. This clutch includes a solenoid **90** embedded in the pulley **56**, as shown. Current is supplied to the solenoid **90** by means of a collector ring **92** cooperating with a brush element **94** carried by the fixed casing element **10**. The solenoid coil **90** is adapted when energized to pull the armature element **96** into frictional engagement with the surface **98** provided on the pulley **56**. The one side of the solenoid **90** is grounded to the pulley **56** and in order to insure proper electrical connection between the pulley assembly and the rest of the compressor, a spring pressed ground contact **91** is provided, as shown, for at all times making electrical connection between the housing **108** of the pulley assembly and the shaft **18**.

When the armature **96** first contacts the surface **98** in response to energization of the solenoid **90**, the armature **96** will tend to rotate with the pulley **56** with the result that a series of conventional spreader balls **100** will serve to force the clutch plate **102** to the right, as viewed in FIGURE 1, so that the friction material **104** carried by the clutch plate **102** will engage the clutch surface **106** formed on the clutch enclosing casing element **108**. The element **108** is secured to the pulley **56** so as to rotate therewith. A plate element **110** which is keyed to the drive shaft **18** is arranged between the armature **96** and the clutch plate **102**. This plate element is secured to the clutch plate **102** through a plurality of arcuate spring members **112**, as best shown in FIGURE 5. One end of each of the spring arms **112** is secured to the plate **110** by means of a rivet **114** and the other end of each of the spring arms is secured to the plate **102** by means of rivets **116**.

A conventional oil seal assembly **120** is provided for preventing the escape of lubricant and refrigerant at the point where the drive shaft **18** passes through the end wall of the casing **10**. Suitable O-ring seals **122** are provided, as shown, for preventing the leakage of gas between various parts of the compressor elements.

In FIGURE 6 of the drawings, a modified form of the invention is shown. Like reference numbers have been used in FIGURES 1 and 6 to designate identical parts or parts which are similar in function. In the modification shown in FIGURE 6, a plain end thrust bearing **200** is provided for the drive shaft **18**. The main drive pulley **202** is rotatably supported on the compressor housing by means of a ball bearing assembly **204** which is directly in line with the drive belts **55** so as to take up the belt load. The clutch for operating the compressor differs from the clutch construction described hereinabove in that in place of using a clutch of the type wherein the clutch surfaces are mechanically held in engagement and the solenoid is merely used to initiate the operation of the clutch, the arangement shown in FIGURE 6 utilizes a clutch of the type in which the solenoid coil **206** holds the clutch in engagement. In the arrangement shown, the solenoid coil **206** which corresponds to the solenoid **90** of FIGURE 1 is arranged in a circular groove **208** formed in the outer face of the pulley **202**. Suitable nonmagnetic material **210** serves to hold the solenoid **206** in place and also serves to support an armature ring **212** which is arranged as shown. Keyed to the shaft **18** is an armature supporting plate assembly **214** which is held in place on the shaft **18** by means of a nut **215**. The plate assembly **214** carries a first ringlike armature element **216** and a second ringlike armature element **218**. The armature supporting plate assembly comprises a rigid plate **230** carried by the shaft **18** and a flexible armature supporting plate **232** to which the armature rings **216** and **218** are secured by means of rivets **234**. Armlike projections **236** formed on the plate **232** and having their extremities secured to the rigid plate **230** by means of rivets **238** enable the armature rings **216** and **218** to move into and out of engagement with the complementary clutch surfaces. The armature ring element **216** is slightly thicker than the element **218** with the result that when the solenoid **206** is first energized, the armature element **216** will move into contact with the surfaces **220** and **222** (see FIGURE 8) and at a subsequent time, the armature element **218** will move into frictional engagement with the surfaces **224** and **226**, as shown in FIGURE 9. The advantage of the above described arrangement is that the pull exerted against the armature **218** serves to increase the pressure between the element **216** and the surfaces **220** and **222**.

The compressor and clutch are of the general type disclosed in United States application Serial Number 496,131, filed March 23, 1955, now Patent Number 2,907,426, issued October 6, 1959, to which reference may be made for a more detailed explanation of the principle of operation thereof.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In combination, a sheet metal casing, a compressor disposed within said casing, a drive shaft extending through one wall of said casing, a bearing sleeve carried by said casing, first bearing means carried by said sleeve rotatably supporting said drive shaft, pulley means having a portion surrounding the outer end of said drive shaft, and second bearing means carried by said sleeve rotatably supporting said pulley means on said sleeve, and clutch means for drivingly connecting said pulley means to said shaft.

2. In combination, a casing, a compressor disposed within said casing, a drive shaft extending through one wall of said casing, a bearing sleeve carried by said casing, first bearing means carried by said sleeve rotatably supporting said drive shaft, pulley means having a portion surrounding the outer end of said drive shaft, and second bearing means carried by said sleeve rotatably supporting said pulley means on said sleeve, and clutch means for drivingly connecting said pulley means to said shaft, said pulley means having a plurality of axially spaced clutch surfaces formed thereon, said clutch means comprising a pair of clutch plates and means for spreading said clutch plates so as to positively force said clutch plates into engagement with said spaced clutch surfaces.

3. In combination, a casing, a compressor disposed within said casing, a drive shaft extending through one wall of

said casing, a bearing sleeve carried by said casing, first bearing means carried by said sleeve rotatably supporting said drive shaft, pulley means secured to the outer end of said drive shaft, and second bearing means carried by said sleeve rotatably supporting said pulley means on said sleeve, and clutch means for drivingly connecting said pulley means to said shaft, said pulley means having a plurality of axially spaced clutch surfaces formed thereon, said clutch means comprising a pair of clutch plates and means for spreading said clutch plates so as to positively force said clutch plates into engagement with said spaced clutch surfaces, said last named means including a solenoid coil carried by said pulley means for initiating operation of said spreading means.

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