

June 2, 1964

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3,135,460

REFRIGERATING APPARATUS

Filed Oct. 19, 1960

5 Sheets-Sheet 1

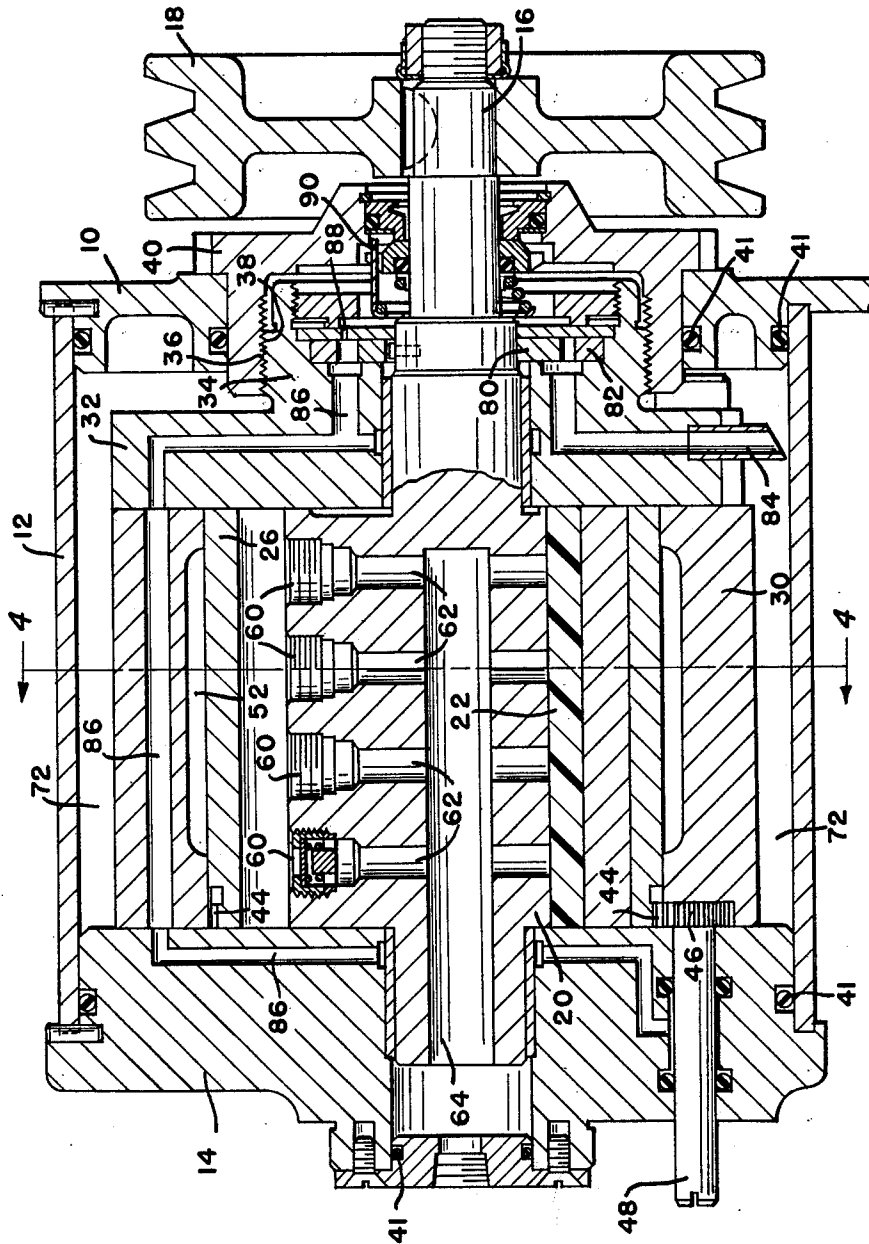


Fig. 1

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5 Sheets-Sheet 2

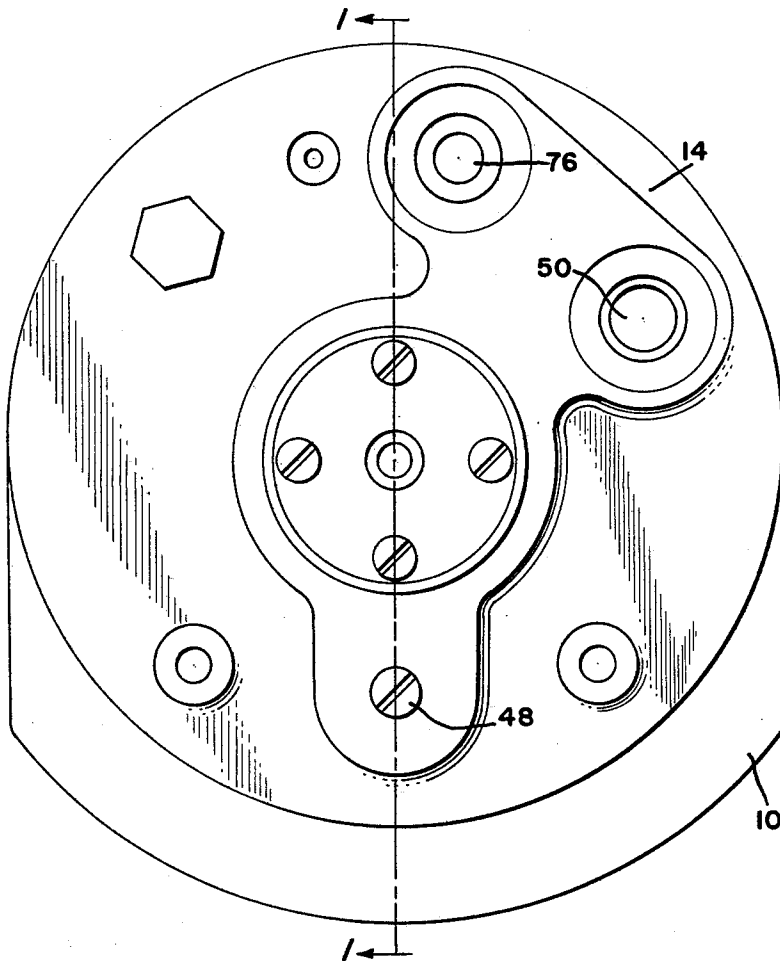


Fig. 2

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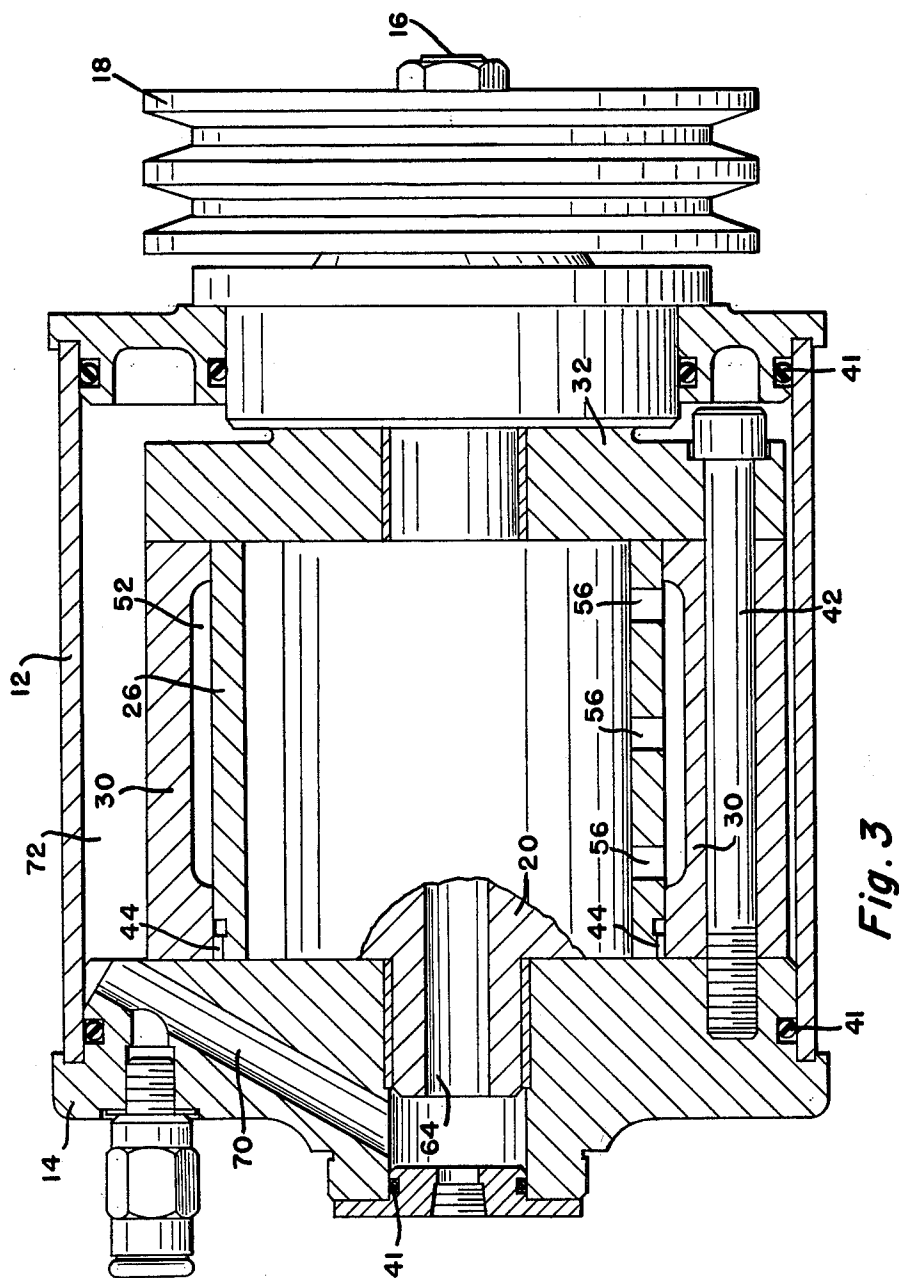
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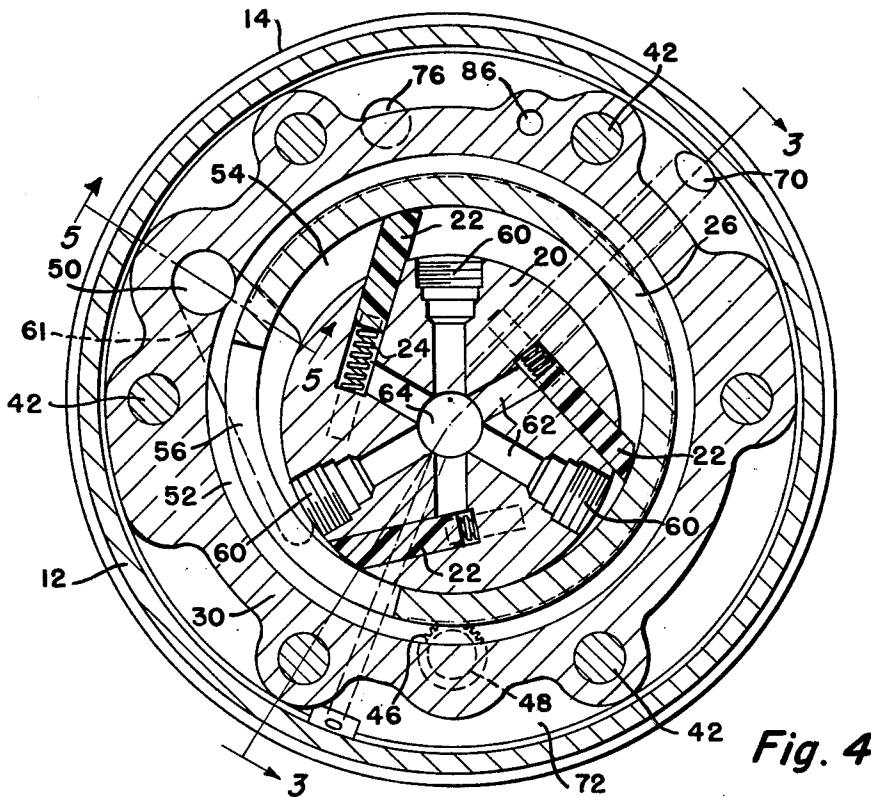


Fig. 4

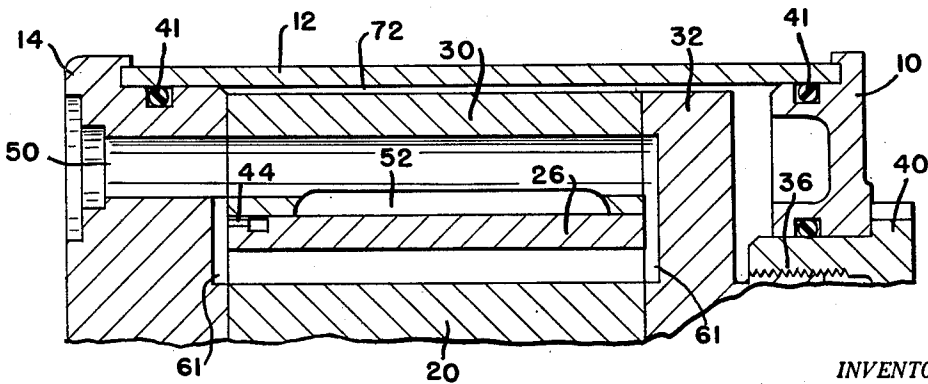


Fig. 5

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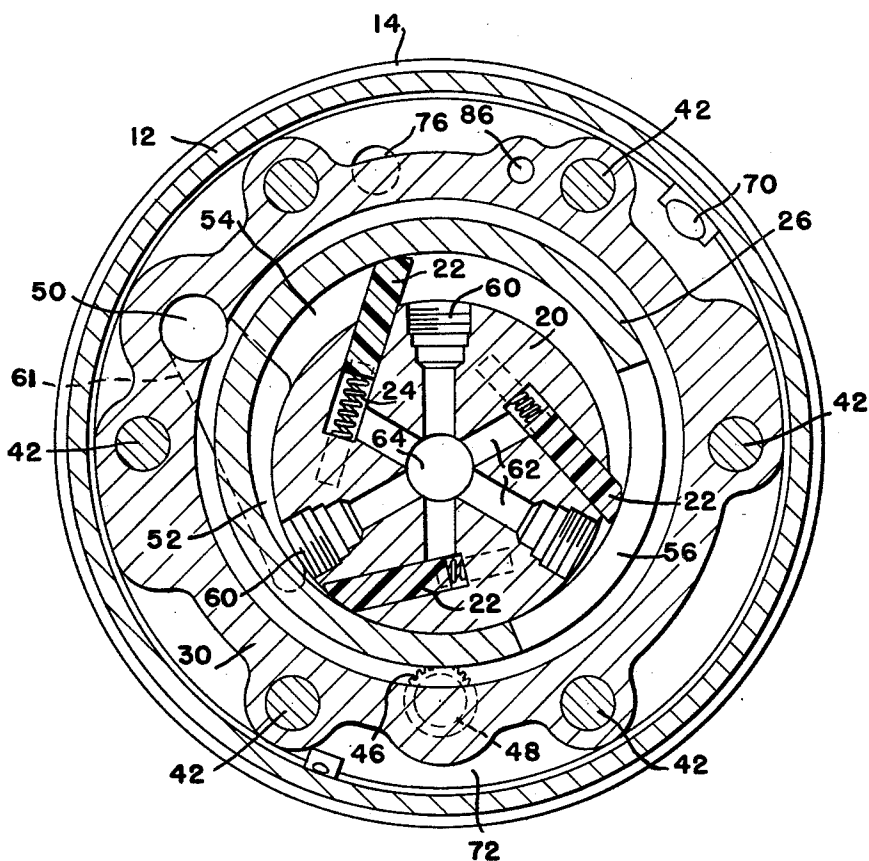


Fig. 6

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3,135,460

REFRIGERATING APPARATUS

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11 Claims. (Cl. 230-138)

This invention relates to refrigerating apparatus and more particularly to a rotary compressor for use in refrigerating systems and the like.

It is an object of this invention to provide a rotary compressor which is inherently balanced without resorting to the use of counterweights.

Another object of this invention is to provide an improved compressor arrangement wherein the torque required for driving the shaft during the compression stroke is distributed over a relatively large angle of rotation so as to reduce the torsional vibration and the starting torque.

Another object of this invention is to provide a compressor wherein the capacity can be readily varied.

Another object of this invention is to provide a rotary compressor wherein the need for critical radial dimensions is minimized.

Another object of this invention is to provide an improved arrangement for holding the compressor assembly in place within the outer housing.

Still another object of this invention is to provide an improved valving arrangement for the compressor wherein the valve noises are not transmitted to the outside of the compressor.

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

In the drawings:

FIGURE 1 is a sectional view taken substantially on line 1-1 of FIGURE 2;

FIGURE 2 is an end elevational view;

FIGURE 3 is a sectional view taken substantially on line 3-3 of FIGURE 4;

FIGURE 4 is a sectional view taken substantially on line 4-4 of FIGURE 1;

FIGURE 5 is a fragmentary sectional view taken substantially on line 5-5 of FIGURE 4; and

FIGURE 6 is a view similar to FIGURE 4 but showing the capacity varying means shifted.

Referring now to the drawings wherein a preferred embodiment of the invention is disclosed, reference numeral 10 designates a stationary support or frame element which forms one end plate of the outer compressor housing. The outer compressor housing includes a cylindrical portion 12 which fits between the stationary frame element 10 and an end plate 14 so best shown in FIGURES 1 and 3 of the drawings. A drive shaft 16 is journaled in the members 10 and 14 and has secured to its outer end a drive pulley 18. The drive shaft 16 has an enlarged impeller portion 20 intermediate its ends which serves to slidably support three vanes 22, as best shown in FIGURE 4 of the drawings. The vanes 22 form a part of the impeller assembly and are biased outwardly by means of coil springs 24.

A cylindrical element 26 surrounds the portion 20 and the vanes 22 so as to form a compression chamber surrounding the impeller assembly. The element 26 is rotatably supported within an outer cylindrical member 30 which surrounds the element 26. The rotatable element 26 is provided with suction or compressor inlet ports 56 which shift with the element 26 so as to vary the capacity of the compressor. The one end of the compression

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chamber is closed by an end plate member 32 which is secured to the member 30 and the end plate 14 by the bolts 42 so as to form a compressor assemblage.

The member 32 is provided with an axial projection 34 which forms an integral part of the end plate 32 and which is provided with external threads 36 which cooperate with internal threads 38 formed on a nut 40. The nut 40, in turn, is rotatably supported in the outer end plate or main frame 10, as best shown in FIGURE 1. When the nut 40 is tightened, the outer housing element 12 is firmly clamped between the stationary frame 10 and the compressor end plate 14. Suitable O-ring seals 41 are provided as needed for preventing the escape of gas at the various joints in the casing. With such an arrangement it is not necessary to weld the joints in the outer casing and consequently the compressor can be disassembled for inspection and repair purposes if necessary.

The member 26 is provided with gear teeth 44 on its outer periphery adjacent the one end of the member 26 and these gear teeth mesh with a pinion 46 secured to the shaft 48. As shown in FIGURE 1 of the drawings, the shaft 48 is journaled in the end plate member 14 and has its outer end exposed to the outside of the compressor casing so as to make it possible to shift the position of the member 26 merely by rotating the shaft 48. Any suitable means, manual or automatic, can be provided for rotating the shaft 48 so as to rotate the cylindrical element 26 to thereby vary the compressor output.

The gas to be compressed enters the compressor through the inlet passage 50 which extends from the inlet in the end plate 14 and throughout the entire length of the member 30 which surrounds the inner cylindrical member 26. Each of the end plates 14 and 32 is provided with a cutaway portion 61 which facilitates the flow of gas into the inlet of the compressor. The member 30 is provided with an internal circumferentially extending groove 52 which assists in distributing the gas to be compressed as it flows from the main compressor inlet 50 into the main compression chamber 54. The inner cylindrical member 26 is provided with a plurality of radial slots 56 through which the gas to be compressed is required to flow. For purpose of illustration three of these slots 56 have been shown, whereas any suitable number of slots could be used.

In the relative position of the inner cylindrical member 26 and the outer cylindrical member 30, as shown in FIGURE 4 of the drawings, the compressor will have maximum capacity, whereas, if the inner cylindrical member 26 is shifted into the position in which it is shown in FIGURE 6, the capacity of the compressor will be materially reduced due to shifting the location of the inlet port slots 56. By shifting these inlet port slots one varies the volume of low pressure gas which is trapped between adjacent vanes before the trailing vane moves past the inlet port slots. Thus, when the cylindrical member 26 occupies the position shown in FIGURE 4, the size of the compression chamber is substantially at its maximum when the trailing vane closes the inlet port slots. The degree of reduction in capacity will, of course, depend upon the extent to which the element 26 has been shifted.

The gas which is compressed by the vanes 22 as they rotate in a clockwise direction is allowed to leave the compression chamber through a plurality of valve outlet ports 60 formed directly in the main rotor 20. As best shown in FIGURES 1, 4 and 6 of the drawings, the rotor 20 is provided with radial passages 62 which communicate with a central bore 64 provided in the shaft 16. By placing the outlet ports directly in the rotor itself, several important advantages result. In the first place the valve noises are not transmitted to the exterior of the compressor unit to any appreciable extent with the result

that the compressor operates very quietly. It will be noted that the compressor does not require any reed valves or the like for the inlet ports 56 and this further adds to the quiet operation of the compressor. Another advantage of providing discharge ports which are arranged, as shown in FIGURE 4 of the drawings, is that the radial passages 62 can be extended so as to vent the inner ends of the slots in which the divider blades 22 are slidably mounted. Thus, the inner ends of the vanes 22 are at all times subjected to a pressure corresponding to the outlet pressure.

The passages 62 in conjunction with the axial passage 64 serve to muffle the compressor discharge noises in a most effective manner. After the compressed gas leaves the passage 64, it flows through a passage 70 (see FIGURE 3) which leads to the space 72 between the outer shell portion 12 and the member 30. Thus, it will be seen that the main compressor cylinder is completely surrounded by high pressure gas and that the chamber 72 can serve as an effective oil separating chamber wherein any droplets of oil discharged from the compressor can settle out from the compressed gas before the compressed gas leaves through the compressor outlet passage 76.

A conventional oil pump including an inner oil gear 80 keyed to the shaft 16 and an outer gear 82 is provided, as shown. The inlet 84 for the oil pump is arranged as shown in FIGURE 1 and serves to withdraw lubricant from the bottom portion of the outer housing element 12. A portion of the oil leaves the oil pump through a series of communicating passages 86 which serve to distribute the oil to the various shaft bearing surfaces and other surfaces requiring lubrication. A portion of the oil leaves the pump through a small port 88 which supplies a limited amount of lubricant to the shaft seal assembly 90. The shaft seal assembly 90 is of conventional construction and serves to prevent the escape of compressed gas at the point where the shaft 16 passes through the element 40. Since the oil seal is of conventional construction, it will not be described in greater detail.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In a rotary compressor, the combination, a stationary member, means carried by said stationary member forming a cylindrical chamber, a rotatable impeller member mounted in said chamber having its axis of rotation offset relative to the central axis of said chamber, said rotatable member having a point of contact with one portion of the inner wall of said chamber, a vane carried by and slidably supported in said rotatable member and separating said chamber into suction and compression chambers, an outlet port in said rotatable member communicating with said compression chamber, an inlet port in said wall and means for shifting the position of said inlet port about the central axis of said chamber relative to said point of contact so as to vary the output of said compressor.

2. In a rotary compressor, a frame, a drive shaft rotatably supported in said frame, cylinder means secured to said frame, impeller means on said shaft within said cylinder means, the axis of rotation of said impeller being offset from the axis of said cylinder means, said impeller being arranged to contact one portion of the inner periphery of said cylinder means, an inlet port provided in said cylinder means, a divider blade carried by said impeller, an outlet port disposed adjacent said divider blade in said impeller, and compressor capacity varying means including means for rotating said cylinder about its axis so as to shift the location of said inlet port relative to the point of contact between said impeller and said cylinder means.

3. In a rotary compressor, a frame, a drive shaft rotatably supported in said frame, cylinder means secured

to said frame, impeller means on said shaft within said cylinder means, the axis of rotation of said impeller being offset from the axis of said cylinder means, said impeller being arranged to contact one portion of the inner periphery of said cylinder means, an inlet port provided in said cylinder means, a divider blade carried by said impeller, an outlet port disposed adjacent said divider blade in said impeller, and compressor capacity varying means including means for rotating said cylinder about its axis so as to shift the location of said inlet port relative to the point of contact between said impeller and said cylinder means, said impeller having a peripheral slot in which said blade reciprocates, and means connecting the inner end of said slot to the outlet port in said impeller.

4. In a rotary compressor, a frame, a drive shaft rotatably supported in said frame, cylinder means secured to said frame, impeller means on said shaft within said cylinder means, the axis of rotation of said impeller being offset from the axis of said cylinder means, said impeller being arranged to contact one portion of the inner periphery of said cylinder means, an inlet port provided in said cylinder means, a divider blade carried by said impeller, an outlet port disposed adjacent said divider blade in said impeller, and compressor capacity varying means including means for rotating said cylinder about its axis so as to shift the location of said inlet port relative to the point of contact between said impeller and said cylinder means, said impeller having a peripheral slot in which said blade reciprocates, and means connecting the inner end of said slot to the outlet port in said impeller, said last named means comprising a radial passage passing through the center of said impeller.

5. In combination, a stationary frame member, a drive shaft, an impeller carried by said drive shaft, cylinder means surrounding said impeller, a pair of end plates closing the ends of said cylinder and forming with said cylinder a compression chamber, means for interconnecting said cylinder means and said end plates, said compression chamber having an inlet port, an outlet port communicating with said compression chamber, one of said end plates having a threaded projection on its one side having threads spaced from but surrounding said shaft, means for attaching said one end plate to said stationary frame including means forming a threaded projection in threaded engagement with said first named threaded projection and further including means in engagement with said stationary frame member for supporting said end plate thereon, said drive shaft being journaled in one of said projections.

6. In combination, a stationary frame member, a drive shaft, an impeller carried by said drive shaft, cylinder means surrounding said impeller, a pair of end plates closing the ends of said cylinder and forming with said cylinder a compression chamber, means for interconnecting said cylinder means and said end plates, said compression chamber having an inlet port, an outlet port, communicating with said compression chamber, one of said end plates having a threaded projection on its one side having threads spaced from but surrounding said shaft, means for attaching said one end plate to said stationary frame including means forming a threaded projection in threaded engagement with said first named threaded projection and further including means in engagement with said stationary frame member for supporting said end plate thereon, said drive shaft being journaled in one of said projections and an outer casing element located between the other of said end plates and said frame member and forming an oil sump between said outer casing element and said cylinder means, said attaching means further including means in axial abutment with said stationary member for clamping said outer casing between said other end plate and said frame member.

7. In combination, a stationary frame member, a drive

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shaft, an impeller carried by said drive shaft, cylinder means surrounding said impeller, a pair of end plates closing the ends of said cylinder and forming with said cylinder a compression chamber, means for interconnecting said cylinder means and said end plates, said compression chamber having an inlet port, an outlet port, communicating with said compression chamber, one of said end plates having a threaded projection on its one side having threads spaced from but surrounding said shaft, means for attaching said one end plate to said stationary frame including means forming a threaded projection in threaded engagement with said first named threaded projection and further including means in engagement with said stationary frame member for supporting said end plate thereon, said drive shaft being journaled in one of said projections and an outer casing element located between the other of said end plates and said frame member and forming an oil sump between said outer casing element and said cylinder means, said attaching means further including means in axial abutment with said stationary member for clamping said outer casing between said other end plate and said frame member, said cylinder means comprising an inner rotatable cylindrical sleeve having an inlet port in its periphery and a stationary cylindrical support for said sleeve having a gas passage communicating with said inlet port.

8. In combination, a stationary frame member, a drive shaft, an impeller carried by said drive shaft, cylinder means surrounding said impeller, a pair of end plates closing the ends of said cylinder and forming with said cylinder a compression chamber, means for interconnecting said cylinder means and said end plates, said compression chamber having an inlet port, an outlet port communicating with said compression chamber, one of said end plates having a threaded projection on its one side having threads spaced from but surrounding said shaft, means for attaching said one end plate to said stationary frame including means forming a threaded projection in threaded engagement with said first named threaded projection and further including means in engagement with said stationary frame member for supporting said end plate thereon, said drive shaft being journaled in one of said projections and an outer casing element located between the other of said end plates and said frame member and forming an oil sump between said outer casing element and said cylinder means, said attaching means further including means in axial abutment with said stationary member for clamping said outer casing between said other end plate and said frame member, said cylinder means comprising an inner rotatable cylindrical sleeve having an inlet port in its periphery and a stationary cylindrical support for said sleeve having a gas passage communicating with said inlet port, said cylindrical sleeve being spaced from said cylindrical support opposite said inlet port so as to provide a gas passage therebetween.

9. In a rotary compressor, a main support, a drive shaft rotatably mounted in said support, impeller means on said shaft, cylinder means surrounding said impeller means, a pair of end plates for closing the ends of said cylinder means, the axis of rotation of said impeller being offset from the axis of said cylinder means, said impeller being arranged to contact one portion of the inner periphery of said cylinder means, an inlet port provided in said cylinder means, a divider blade carried by said impeller,

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an outlet port disposed adjacent said divider blade in said impeller, and means for rotating said cylinder about its axis so as to shift the location of said inlet port.

10. In combination, a stationary frame member, a drive shaft, an impeller carried by said drive shaft, cylinder means surrounding said impeller, a pair of end plates for closing the ends of said cylinder means, a plurality of bolts for securing said end plates to said cylinder means, one of said end plates having a threaded projection on its one side, a nut rotatably carried by said stationary frame member having a first portion in axial abutment with said stationary frame member and having a second portion projecting through said frame member for engaging said threaded projection so as to hold said cylinder means and end plates in assembled relationship on said frame member.

11. In a rotary compressor, the combination, a stationary member, a drive shaft rotatably mounted on said member, means carried by said stationary member forming a cylindrical compression chamber, a rotatable impeller on said shaft and disposed in said chamber, said rotatable impeller being smaller in diameter than said chamber and having contact with the wall of the chamber adjacent one side of said shaft, a vane slidably supported in the outer periphery of said impeller, an outlet port in said impeller, a valve in said outlet port, a gas passage formed in said shaft and communicating with said outlet port, and means for subjecting the inner end of said vane to a pressure corresponding to the pressure in said gas passage, said last named means comprising a radially extending passage in alignment with and forming an extension of said outlet port.

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