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J. H. HEIDORN ET AL
REFRIGERATING APPARATUS

2,864,551

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2 Sheets-Sheet 1

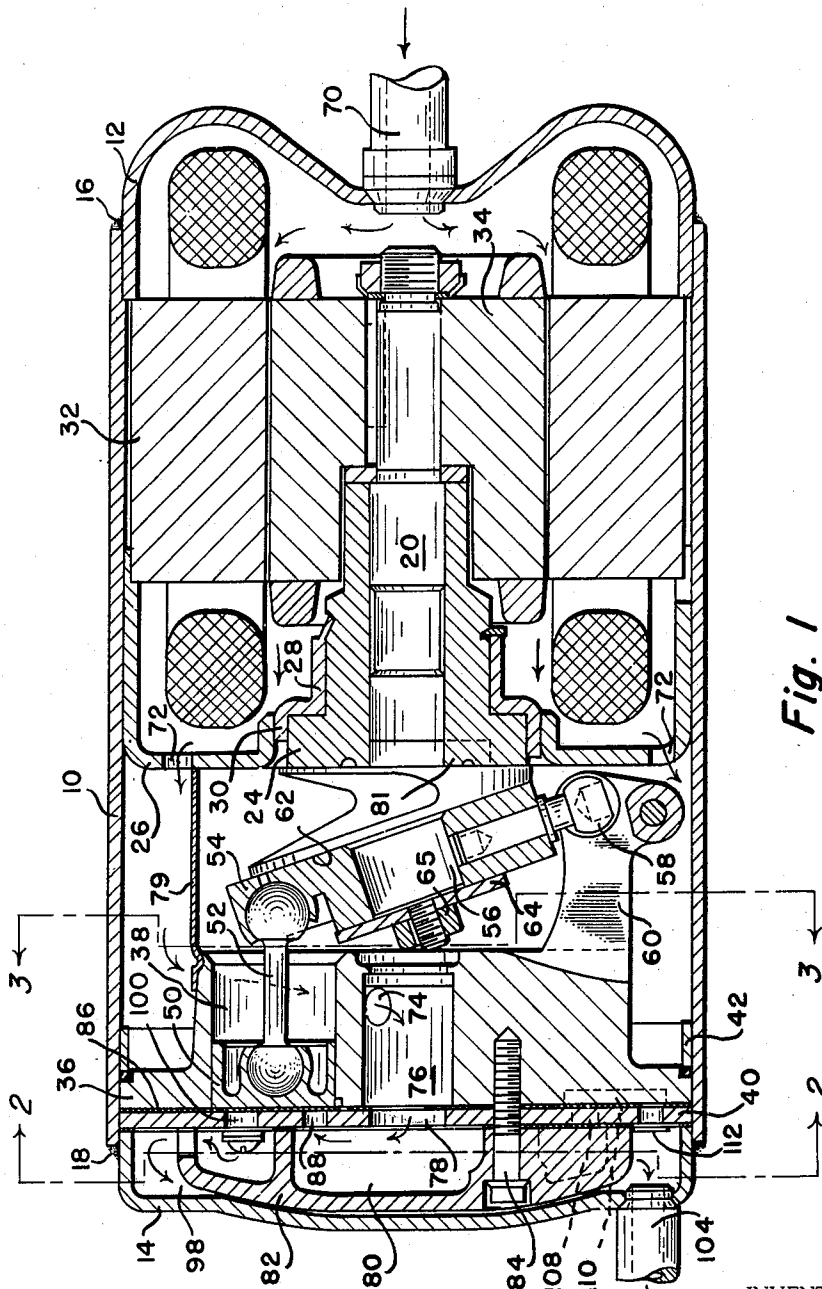


Fig. 1

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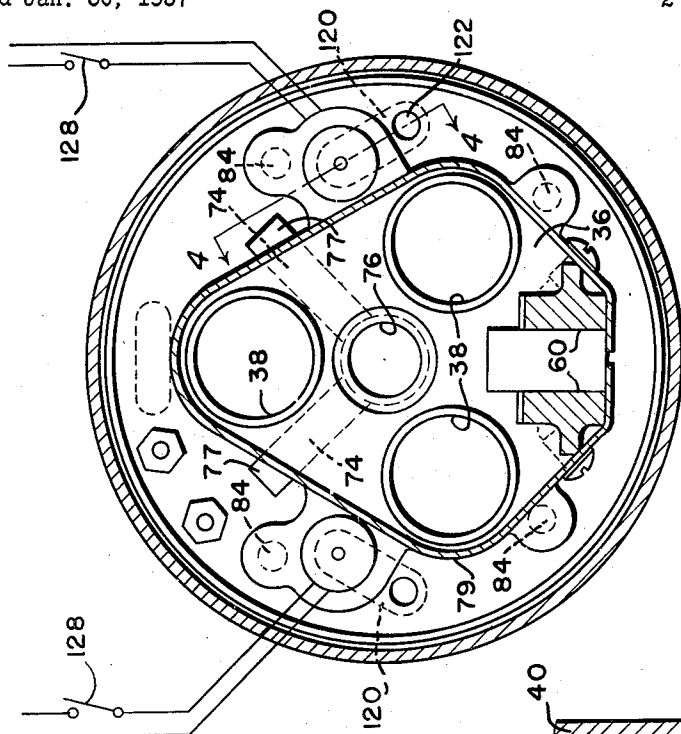


Fig. 3

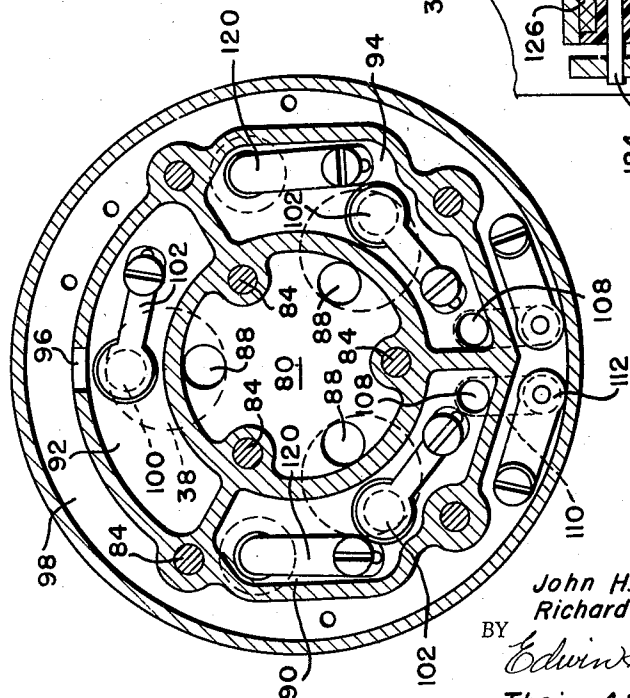


Fig. 2

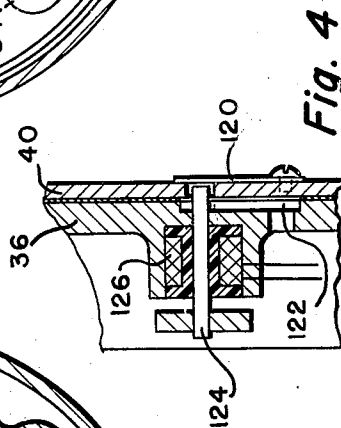


Fig. 4

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REFRIGERATING APPARATUS

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7 Claims. (Cl. 230—58)

This invention relates to refrigerating apparatus and more particularly to a low-cost variable capacity motor compressor unit.

It is an object of this invention to provide a low-cost axial type compressor which lends itself to mass production methods.

Another object of this invention is to provide an improved arrangement for unloading one or more cylinders of a multiple cylinder 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 form of the present invention is clearly shown.

In the drawings:

Figure 1 is a vertical sectional view showing a preferred embodiment of the invention;

Figure 2 is a vertical sectional view taken substantially on line 2—2 of Figure 1;

Figure 3 is a vertical sectional view taken substantially on line 3—3 of Figure 1; and

Figure 4 is a fragmentary sectional view taken substantially on line 4—4 of Figure 3 and showing the unloader for one of the cylinders.

Referring now to the drawings wherein a preferred embodiment of the invention has been shown, reference numeral 10 designates an outer cylindrical sheet metal housing having sheet metal end walls 12 and 14 arranged as shown. These end walls are welded to the ends of the cylindrical portion 10 as indicated at 16 and 18 respectively.

The motor compressor mechanism comprises a main drive shaft 20 journaled in a bearing element 24 which is held in place within the central portion of the cylindrical casing 10 by means of a sheet metal element 26. The element 26 divides the casing into two compartments. As shown in the drawings, a stamped sheet metal sleeve 28 surrounds the bearing 24 and has a flange portion 30 which is welded or otherwise secured to the bearing support 26.

The shaft 20 is adapted to be driven by means of an electric motor which includes a stator portion 32 and a rotor 34. As shown in the drawing, the stator 32 is held in place between the stamping 26 and the stamping 12. The rotor 34 is keyed to the one end of the shaft 20 as shown.

The compressor is of the multiple cylinder axial type and includes a main cylinder block or casting 36 having a plurality of cylinder bores 38 which are arranged as shown. The block 36 is held in place between the valve plate assembly 40 and a positioning ring 42 which is welded or otherwise secured to the inner wall of the cylindrical casing 10. The valve plate assembly 40 in turn is held in place by the cylinder head stamping 14.

A piston such as the piston 50 shown in Figure 1 operates in each of the cylinder bores and each piston is adapted to be driven by means of a connecting rod 52 which in turn is driven by the wobble plate 54 rotatably mounted on the off-set crank portion 56 formed on the

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one end of the main drive shaft 20. The wobble plate 54 is held against rotation by means of a conventional guide pin assembly 58 which operates between two guide members 60 formed integrally with the cylinder block 36. It will be noted that the wobble plate element 54 is held in place between the end thrust bearing surface 62 formed directly on the drive shaft 20 and a retaining bearing or washer-like element 64 which is held in place on the free end of the shaft 20 by means of the nut 65.

The gas to be compressed enters the motor compressor unit through the suction line 70 and is required to flow through the air gap between the motor stator 32 and the motor rotor 34 so as to cool the motor. The gas to be compressed leaves the motor chamber through a plurality of apertures 72 provided in the stamping 26 and then flows through gas passages 74 which lead to the central bore 76 formed in the cylinder block 36. The entrances to the passages have short sections of tubing 77 projecting therefrom so as to prevent any lubricant which might collect on the cylinder block 36 from entering the passages 74. An oil guard 79 surrounds the wobble plate assembly so as to prevent lubricant from being sprayed into the gas flowing from the inlet 70 to the passages 74. The gas then flows through an aperture 78 formed in the valve plate assembly 40 and enters a suction chamber 80 formed in the casting element 82 which is bolted to the valve plate 40 by means of cap screws. The valve plate assembly is of conventional construction and includes the usual inlet valve reed plate 86 which controls the flow of refrigerant from the suction chamber 80 through suction ports 88 formed in the valve plate 40.

For a more detailed description of the inlet and outlet valve ports and such items as the inlet valve reed plate 86 reference is hereby made to application S. N. 430,768 filed May 19, 1954, now Patent No. 2,825,499.

As best shown in Figure 2 of the drawing the casting element 82 not only includes the suction chamber 80 but also includes discharge chambers 90, 92 and 94 which receive compressed gas leaving the cylinders through their outlet ports 100. Conventional reed valves 102 control the flow through the ports 100. It will be noted that the one chamber 92 is provided with an aperture 96 which directly communicates with the space or chamber 98 which is formed between the casting 82 and the end wall 14 of the motor compressor housing. Outlet line 104 conveys the compressed refrigerant to a condenser (not shown) of a conventional refrigerating system. Two of the three cylinders each discharge compressed refrigerant into one of the chambers 90 and 94. Under normal operating conditions when maximum compressor capacity is desired all of the compressed refrigerant entering the chambers 90 and 94 will flow downwardly through a port 106 which communicates with a cut away portion 110 formed in the one end of the cylinder block 36 and is then free to flow through a second discharge valve 112 which leads to the main or common discharge chamber 98.

When the compressor has excess capacity it is possible to unload either one or two of the cylinders so as to reduce the compressor output. As shown in Figures 2, 3 and 4, each of the chambers 90 and 94 is provided with an unloader valve 120 which allows compressed refrigerant to escape the associated chamber through a passage 122 formed in the plate 40 and the cylinder block 36 so as to return the compressed refrigerant to the inlet side of the compressor.

For purposes of illustration there is shown a compressor having three cylinders with means for unloading two of the cylinders. Each unloader valve 120, as best shown in Figure 4, is adapted to be opened by means of an electromagnet which includes an armature element 124 and a magnetic coil or solenoid means 126. Upon energizing

zation of one of the solenoids 126, the associated armature 124 moves so as to hold its valve 120 open. The energization of the solenoids 126 may be controlled in any convenient manner such as by means of switches 128. These switches may be operated either manually or automatically in response to some condition such as the pressure within the refrigerating system, the refrigeration requirements, or any other condition which would indicate the need for more or less compressor capacity.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. In a sealed motor compressor unit, a cylindrical sheet metal casing, stamped sheet metal end caps for said casing, motor compressor means disposed within said casing and including a drive shaft, a bearing for said drive shaft, stamped sheet metal bearing mounting means having an outer annular flange portion arranged in engagement with the inner wall of said cylindrical casing and having an inner flange portion arranged to encompass said bearing throughout a substantial portion of the axial length of said bearing, said bearing comprising the sole means for supporting said shaft, the ends of said shaft projecting beyond the opposite ends of said bearing, a motor rotor secured to one end of said shaft and having a portion arranged in overlapping relationship to said bearing, a motor stator supported by said casing in a position surrounding said motor rotor, the one end of said shaft having an offset crank portion and an angularly disposed bearing surface, a wobble plate supported on said offset crank portion in bearing relationship to said angularly disposed bearing surface, a cylinder block supported within said casing and having a plurality of cylinder bores forming compression chambers, means forming inlet and outlet ports for said compression chambers, piston means operating within said cylinder bores, and means drivingly connecting said piston means to said wobble plate.

2. In a sealed motor compressor unit, a cylindrical sheet metal casing, stamped sheet metal end caps for said casing, motor compressor means disposed within said casing and including a drive shaft, a bearing for said drive shaft, stamped sheet metal bearing mounting means having an outer annular flange portion arranged in engagement with the inner wall of said cylindrical casing and having an inner flange portion arranged to encompass said bearing throughout a substantial portion of the axial length of said bearing, said bearing comprising the sole means for supporting said shaft, the ends of said shaft projecting beyond the opposite ends of said bearing, a motor rotor secured to one end of said shaft and having a portion arranged in overlapping relationship to said bearing, a motor stator supported by said casing in a position surrounding said motor rotor, the one end of said shaft having an offset crank portion and an angularly disposed bearing surface, a wobble plate supported on said offset crank portion in bearing relationship to said angularly disposed bearing surface, a cylinder block supported within said casing and having a plurality of cylinder bores forming compression chambers, means forming inlet and outlet ports for said compression chambers, piston means operating within said cylinder bores, means drivingly connecting said piston means to said wobble plate, and means for directing compressed gas leaving one of said compression chambers to said inlet ports so as to reduce the effective output of said compressor means.

3. In a sealed motor compressor unit, a cylindrical casing, motor compressor means disposed within said casing and including a drive shaft, a bearing for supporting said drive shaft, stamped sheet metal bearing mounting means having an outer annular flange portion arranged in engagement with the inner wall of said cylindrical

casing and having an inner flange portion arranged to encompass said bearing throughout a substantial portion of its axial length, the ends of said shaft projecting beyond the ends of said bearing, a motor rotor secured to one end of said shaft, a motor stator supported by said casing in a position surrounding said motor rotor, said shaft having an offset crank portion and an angularly disposed bearing surface, a wobble plate supported on said offset crank portion and having one side arranged in bearing relationship to said angularly disposed bearing surface, a cylinder block supported within said casing and having a plurality of cylinder bores forming compression chambers, piston means operating within said cylinder bores, means drivingly connecting said piston means to said wobble plate, means forming inlet and outlet ports for said compression chambers, cylinder head means arranged adjacent said ports, said cylinder head means having a plurality of separate chambers arranged to receive the compressed refrigerant leaving each of said outlet ports and having a common outlet chamber, and means selectively directing the compressed refrigerant leaving one of said separate chambers either to the inlet of said compression chambers or to said common outlet chamber.

4. In combination, a casing, a compressor disposed within said casing, said compressor including a cylinder block having a plurality of compression chambers in which pistons operate, a valve plate assembly secured to said cylinder block adjacent the one end of said compression chambers, said valve plate assembly having a plurality of outlet ports communicating with said compression chambers, cylinder head means arranged in abutting relationship to said valve plate assembly and having a separate outlet chamber for each of a plurality of said compression chambers and having a final outlet chamber communicating with each of said separate chambers through communicating passageways, a check valve in a passageway between one of said separate chambers and said final outlet chamber, and means directing gas discharged into said one separate chamber to the inlet of said compressor so as to reduce the output of said compressor.

5. In combination, a casing, a compressor disposed within said casing, said compressor including a cylinder block having a plurality of compression chambers in which pistons operate, a valve plate assembly secured to said cylinder block adjacent the one end of said compression chambers, said valve plate assembly having a plurality of outlet ports communicating with said compression chambers, cylinder head means arranged in abutting relationship to said valve plate assembly and having a separate outlet chamber for each of a plurality of said compression chambers and having a final outlet chamber communicating with each of said separate chambers through communicating passageways, a check valve in a passageway between one of said separate chambers and said final outlet chamber, and means directing gas discharged into said one separate chamber to the inlet of said compressor so as to reduce the output of said compressor, said last named means comprising solenoid operated valve means for directing gas from said one separate chamber through communicating apertures in said valve plate assembly and said cylinder block.

6. In combination, a casing, a compressor disposed within said casing, said compressor including a cylinder block having a plurality of compression chambers in which pistons operate, a valve plate assembly for closing the one end of said compression chambers, said valve plate having a plurality of outlet ports communicating with said compression chambers, inlet means for admitting gas to be compressed to said compression chambers, cylinder head means arranged in abutting relationship to said valve plate assembly and having a plurality of individual chambers formed therein adjacent each outlet port and a common outlet chamber for receiving gas from said individual chambers, and means selectively

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directing compressed gas discharged into one of said individual chambers to said inlet means or to said common outlet chamber, said means for selectively directing the gas comprising a first pressure operated valve operable to direct compressed refrigerant from said one individual chamber into said common outlet chamber in response to a predetermined pressure differential on opposite sides of said pressure operated valve and a second valve means for connecting said one individual chamber to said inlet means and thereby prevent opening of said pressure operated valve.

7. In a multiple cylinder compressor, a cylinder block having a plurality of cylinders therein, cylinder head means secured to said cylinder block, said cylinder head means having a first chamber therein forming a common inlet chamber for all of said cylinders and having a

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separate outlet chamber therein for each of said cylinders and a common outlet chamber receiving gas from all of said separate outlet chambers, means for connecting one of said separate outlet chambers to said common outlet means including a pressure operated valve, and separate means for connecting said one separate chamber to said inlet chamber so as to reduce the effective output of said compressor.

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