July 5, 1960 R. McGREGOR 2,943,782

REFRIGERATING APPARATUS

Filed May 29, 1957 3 Sheets-Sheet 1

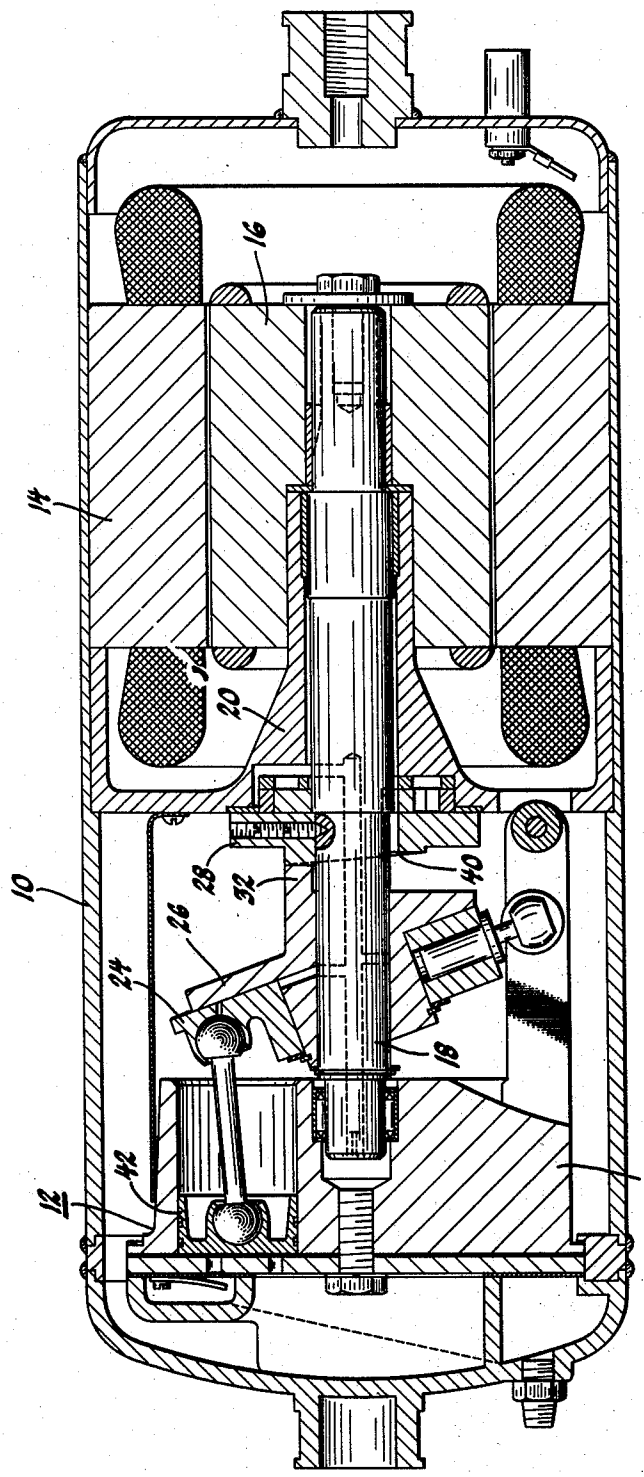


Fig. 1

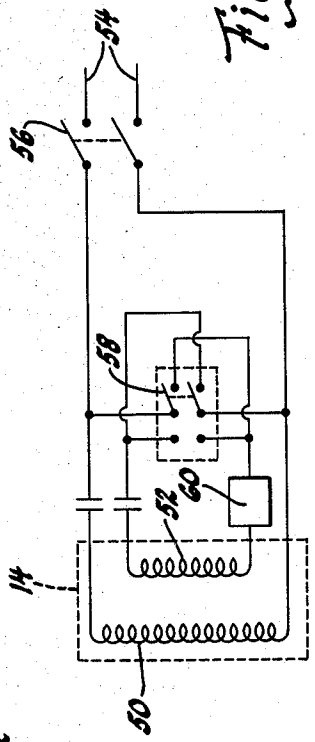


Fig. 6

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REFRIGERATING APPARATUS

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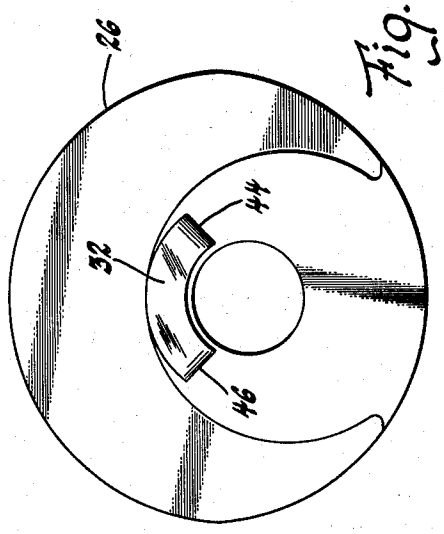


Fig. 3

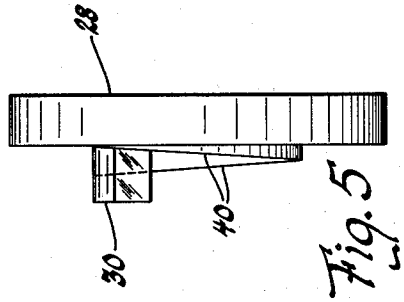


Fig. 5

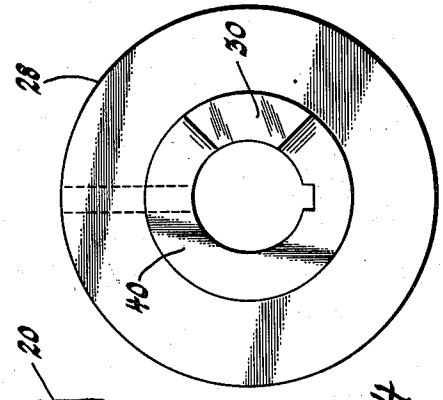


Fig. 4

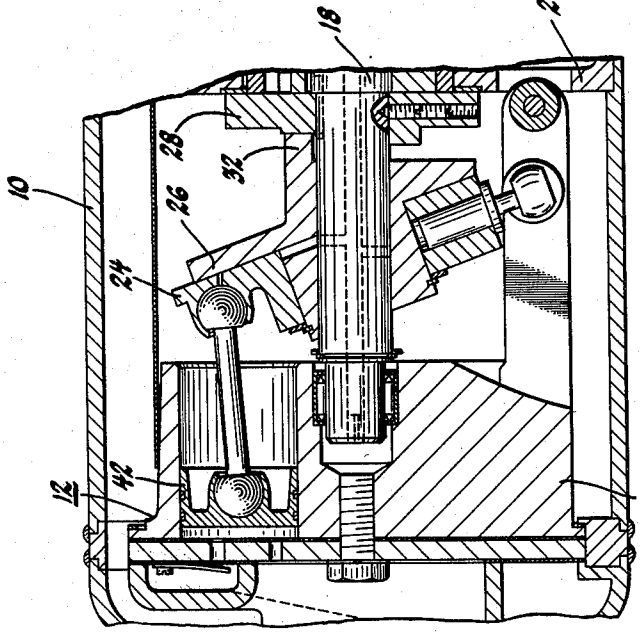


Fig. 2

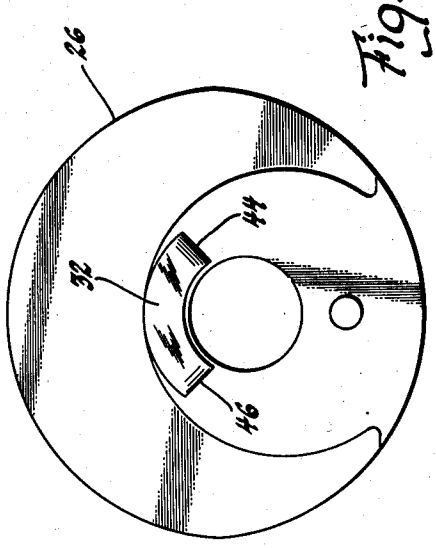
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REFRIGERATING APPARATUS

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Fig. 8



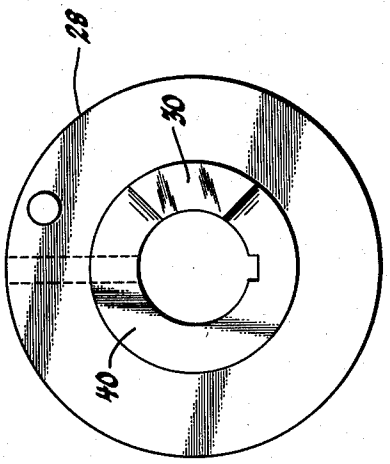


Fig. 9

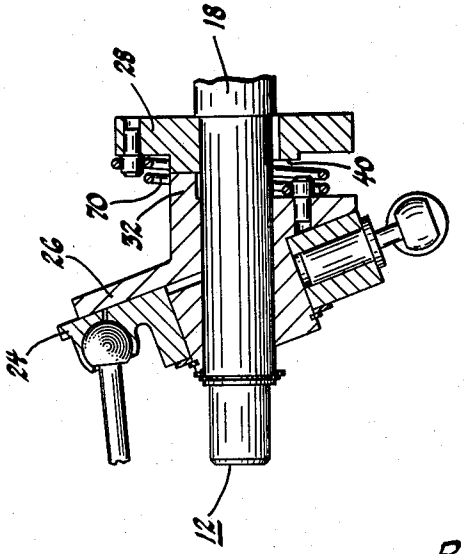


Fig. 7

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2,943,782

REFRIGERATING APPARATUS

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Filed May 29, 1957, Ser. No. 662,515

3 Claims. (Cl. 230—20)

This invention relates to refrigerating apparatus and more particularly to a variable output refrigerant compressor.

It is an object of this invention to provide a refrigerant compressor or the like having a new and improved arrangement for varying its output so as to maintain a proper balance between the compressor output and the refrigeration requirements.

It is another object of this invention to provide a compressor having an output varying means which automatically changes the output of the compressor in response to a change in the direction of rotation of the compressor operating means.

Still another object of this invention is to provide a compressor in which the head clearance may be adjusted so as to adjust the effective capacity 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 form of the present invention is clearly shown.

In the drawings:

Figure 1 is a vertical sectional view showing an axial type compressor embodying the invention;

Figure 2 is a fragmentary vertical sectional view showing the arrangement of the parts when the compressor operates at a reduced capacity;

Figure 3 is an elevational view showing a portion of the wobble plate assembly;

Figure 4 is an end elevational view showing the head clearance adjusting cam;

Figure 5 is a side elevational view of the member shown in Figure 4;

Figure 6 is a schematic circuit diagram showing the arrangement for reversing the direction of rotation of the motor for varying the output of the compressor;

Figure 7 is a fragmentary sectional view showing a modified arrangement for varying the head clearance adjustment; and

Figures 8 and 9 are similar to Figures 3 and 4 but show the modified head clearance adjusting means.

Referring now to the drawings wherein a preferred embodiment of the invention has been shown, reference numeral **10** generally designates a motor compressor housing which serves to enclose an axial type compressor generally designated by the reference numeral **12** and a driving motor including a motor stator **14** and a motor rotor **16**. The motor rotor **16** is directly secured to the one end of the main drive shaft **18**. The shaft **18** has its one end journalled in a main frame **20** and has its other end journalled in the cylinder block **22** as shown. The compressor is of the axial type wherein a wobble plate element **24** is journalled on an angularly disposed bearing element or crank portion **26** which is normally adapted to be driven in unison with the shaft **18** by means of the head clearance adjusting cam plate **28** which is keyed to the shaft **18** so as to rotate with the shaft **18** at all times. The cam plate **28** as best shown in Figures 1, 4 and 5 is provided with a driving lug **30** which is adapted to drivingly engage a lug **32** carried by the crank element **26**.

It will be noted that the construction and arrangement of the lugs **30** and **32** is such that a limited amount of relative rotation can take place between the cam plate **18** and the crank portion **26**. It will also be noted that the lug **32** is adapted to engage the inclined cam surface **40** provided on the cam plate **28** with the result that relative rotation between the cam plate **28** and the crank element **26** serves to axially move the crank element **26** on the shaft **18**. This axial movement can be obtained by reversing the direction of rotation of the motor and causes a change in the head clearance adjustment which, in turn, causes a change in the output of the compressor. In Figure 1 of the drawing, the parts are shown occupying the position which they occupy when the compressor is operating at maximum capacity whereas Figure 2 of the drawing shows the relative position of the parts when the compressor operates at its minimum capacity.

The compressor inlet and outlet valves are of the type more fully disclosed in copending United States applications S.N. 640,025, filed February 13, 1957, and S.N. 430,768, filed May 19, 1954, now Patent No. 2,825,499, to which reference is hereby made for a more complete disclosure of the compressor per se. The output varying means shown herein is equally applicable to pumps handling liquids and to pumps driven by externally disposed prime movers. In order to simplify the disclosure only the one pump piston **42** has been shown whereas the compressor has five uniformly spaced pistons.

By virtue of the above described arrangement, the capacity of the compressor may be changed merely by reversing the direction of rotation of the main drive shaft **18**. Thus, when the drive shaft **18** rotates in the one direction, the driving lug **30** is adapted to engage the end surface **44** of the complementary lug **32** formed on the wobble plate driving crank **26** and, when the motor operates in the opposite direction, the lug **30** will engage the surface **46**. Any conventional means may be provided for reversing the direction of the drive motor. For purposes of illustration, there is shown in Figure 6 a circuit diagram of one form of motor reversing system. As shown in Figure 6, the motor stator **14** includes a main winding **50** and a starting winding **52**. These windings are adapted to be connected to a power source, designated by reference numeral **54**, by means of a main control switch **56**. The direction of rotation of the motor is controlled by means of a polarity reversing switch **58** which is used for connecting the starting winding **52** to the power supply. The switches **56** and **58** may be operated manually or automatically so as to vary the output of the compressor in accordance with refrigeration requirements. A conventional starting winding control **60** serves to deenergize the starting winding when the motor comes up to speed in accordance with standard practice.

In Figures 7, 8 and 9 of the drawings, there is shown a modified arrangement wherein the relative positions of the elements **26** and **28** are controlled by means of a torsion spring **70** which normally biases the parts to the position in which the compressor has minimum head clearance and consequently maximum output. In the event that the load on the compressor becomes excessive either because of an excessive increase in the condenser pressure or because of an excessive increase in the speed of the driving element, the wobble plate operating member **26** will shift relative to the cam plate **28** so as to automatically increase the head clearance adjustment and thereby reduce the output of the compressor. The spring is so arranged that the compressor normally operates at maximum capacity but, as the load on the compressor increases, the spring tends to yield so as to allow the element **26** to

shift relative to the element 28 in a direction whereby the head clearance increases.

Whereas Figure 1 of the drawing shows a compressor operated by means of a reversible motor, it is apparent that certain aspects of the invention would be equally applicable to an arrangement in which some other form of prime mover would be used for driving the compressor. Thus, the arrangement shown in Figures 7, 8 and 9 is particularly applicable to a compressor driven by means of a car engine or the like wherein the speed of the compressor drive shaft would be varied without any relation to the compressor requirements. In systems of this latter type, it is desirable to provide means for automatically reducing the capacity of the compressor at high engine speeds when the compressor has a capacity greatly in excess of the capacity required at a given time.

While the embodiment of the 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 combination, a pump including a drive shaft having an offset crank portion, a wobble plate assembly disposed on said crank portion, a cylinder block having a plurality of cylinders parallel to the axis of rotation of said shaft, piston means operating in said cylinders and driven by said wobble plate assembly, said assembly comprising a pair of relatively rotatable elements, means for securing one of said elements to said shaft, and means responsive to relative rotation of said elements for shifting the other of said elements axially on said shaft, said last named means comprising an inclined cam surface on one of said elements and a cam follower on the other of said elements slidably engaging said cam surface.

2. In combination, a pump including a drive shaft having an offset crank portion, a wobble plate assembly disposed on said crank portion, a cylinder block having a plurality of cylinders parallel to the axis of rotation of said shaft, piston means operating in said cylinders and driven by said wobble plate assembly, said assembly comprising a pair of relatively rotatable elements, means for securing one of said elements to said shaft, and means responsive to relative rotation of said elements for shifting the other of said elements axially on said shaft.

3. In combination, a pump including a drive shaft having an offset crank portion, a wobble plate assembly disposed on said crank portion, a cylinder block having a plurality of cylinders parallel to the axis of rotation of said shaft, piston means operating in said cylinders and driven by said wobble plate assembly, said assembly comprising a pair of relatively movable elements, one of said elements having an axially extending driving lug formed thereon and the other of said elements having a circularly disposed inclined cam surface arranged to engage said driving lug whereby relative rotation between said elements produces axial displacement of said elements, means for limiting the extent of relative rotation of said elements, and means for reversing the direction of rotation of said driveshaft.

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