

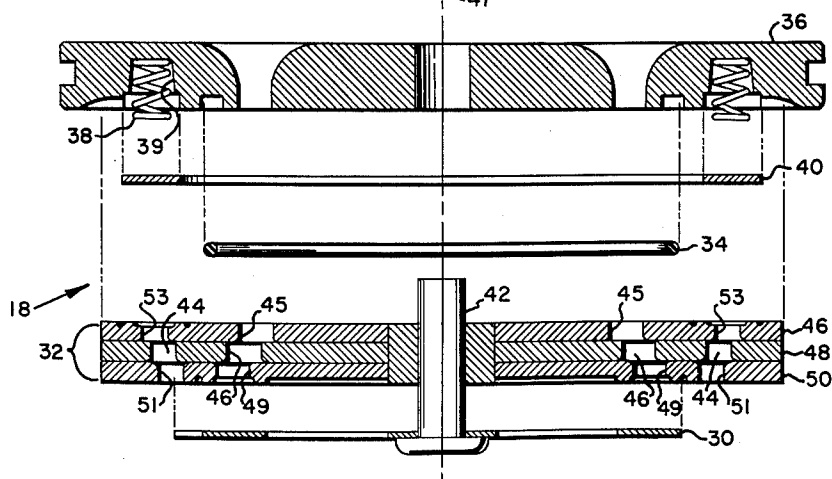
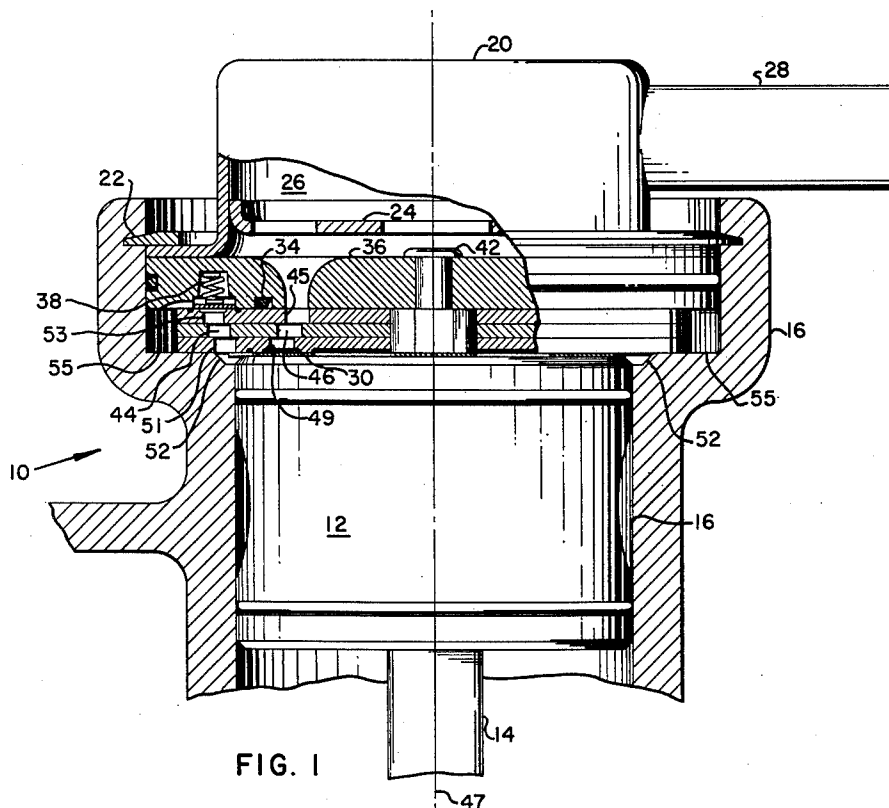
Dec. 4, 1962

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VALVE ASSEMBLY

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2 Sheets-Sheet 1



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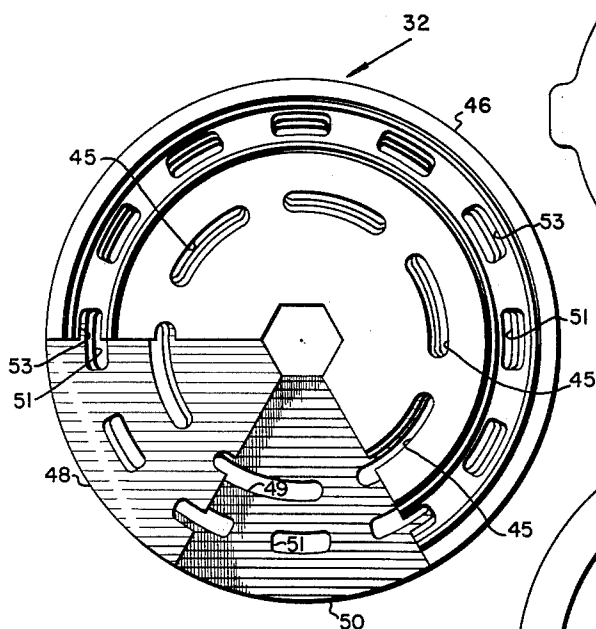


FIG. 4

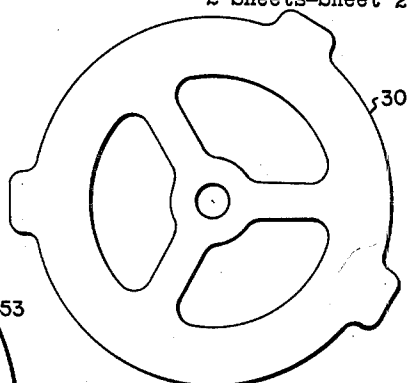


FIG. 3

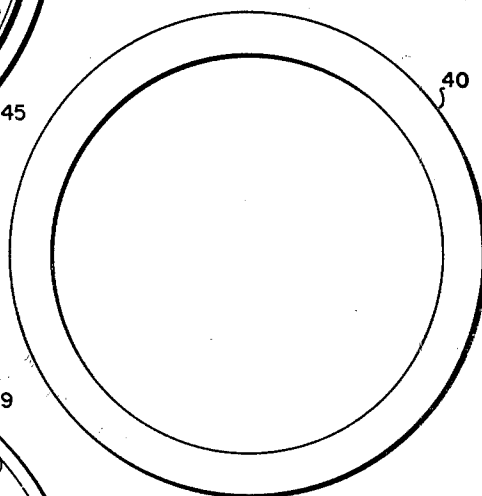


FIG. 5

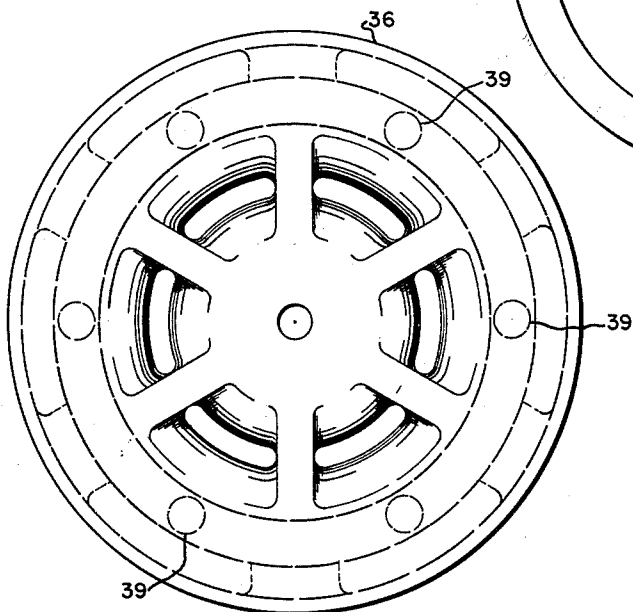


FIG. 6

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VALVE ASSEMBLY

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3 Claims. (Cl. 230—231)

This invention relates generally to reciprocating compressors and more particularly to reciprocating refrigeration compressors with a new and novel suction-discharge valve assembly.

An object of the invention is to provide a reciprocating compressor with a new and novel valve assembly which provides a small clearance volume and higher volumetric efficiencies.

Another object of the invention is to provide reciprocating compressors with a new valve assembly with excellent suction gas entrance conditions and lower suction gas velocities which decrease the pressure drop loss on the suction stroke.

A third object of the invention is to provide a reciprocating compressor with a new and novel valve assembly which provides higher over-all compressor efficiency.

A fourth object of the invention is to provide a reciprocating compressor with a new and novel valve assembly which is cheaper to produce and is more readily assembled.

A still further object of the invention is to provide a reciprocating compressor with a new and novel valve assembly with means on the cylinder casing to provide a stop means for the suction valve and a lead-in for the compressed gas to the discharge valve.

A sixth object of the invention is to provide a new and novel suction-discharge valve assembly for reciprocating compressors which incorporates a laminated valve plate of unique design which is simpler and more inexpensive to produce.

A still further object of the invention is to provide a new and novel suction-discharge valve assembly with a laminated valve plate to allow stepped suction and discharge passages without excessive machine work.

Other objects and advantages of the invention will become apparent as the specification proceeds to describe the invention with reference to the drawings in which:

FIG. 1 is an elevation view partly in cross section of one cylinder of a reciprocating compressor showing in detail the new suction-discharge valve assembly;

FIG. 2 is an exploded sectional view of the valve assembly shown in FIG. 1;

FIG. 3 is a top elevational view of the suction valve shown in FIG. 2;

FIG. 4 is a top elevational view of the valve plate shown in FIG. 2 with part of the plate broken away;

FIG. 5 is a top elevational view of the discharge valve shown in FIG. 2; and

FIG. 6 is a top elevational view of valve cage shown in FIG. 2.

Looking now at FIG. 1, reference number 10 represents one cylinder of a reciprocating compressor. Preferably, the compressor is of the type normally used to pump refrigerant gas but is not necessarily limited to such application.

Piston member 12 is rotatably mounted on a crankshaft (not shown) by a connecting rod 14 and reciprocates in compression chamber 16 of cylinder 10. Valve assembly 18 and head member 20 are secured into position above piston member 12 by means of a snap ring 22. Mounted within head member 20 is a baffle member 24 to form a muffle chamber or suction chamber 26 for suction gas introduced into the cylinder via suction conduit 28.

FIGS. 2-6 illustrate the valve assembly 18 in greater

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detail. Valve assembly 18 consists of a suction valve 30, a laminated valve plate 32, an O-ring 34, a valve cage 36, discharge valve springs 38 in openings 39 to bias discharge valve 40 to the closed position, and a fastener 42 to secure the valve assembly 18 in assembled relationship. It should be noted that O-ring 34 seals the discharge passage 44 from the suction passage 46 so that refrigerant does not leak from the discharge side to the suction side of the valve assembly.

Valve plate 32 is of laminated construction and is comprised of a valve top plate 46, a valve middle plate 48, a valve bottom plate 50. These plates are formed by stamping or any other suitable operation and can be brazed or otherwise secured together. This laminated construction allows the use of stepped suction and discharge passages, for the reasons set forth hereinafter, without excessive machine work. Suction passage 46 is so stepped that the centerlines of slots 45 in valve top plate 46 are radially closer to the centerline 47 of cylinder 10 than the centerlines of slots 49 in valve bottom plate 50. Discharge passages 44 are stepped so that the centerlines of slot 51 in valve bottom plate 50 are radially closer to centerline 47 of cylinder 10 than the centerlines of slots 53 in valve top plate 46. It is readily apparent that such construction could not be obtained if the valve plate 32 was cast as an integral unit without excessive machining or higher mold costs.

It should be noted that valve plate 32 has the discharge passages 44 outside the suction passages 46 in order to draw the suction gas into the center of the valve assembly 18 and discharge compressed gas at the periphery thereof. Preferably, such passages are slot shaped but obviously other shapes come within the scope of the invention. This construction in conjunction with the stepped suction and discharge passages results in a smaller clearance volume, lower lift velocities at the suction valve, lower pressure drop through the suction passages and valve, and higher volumetric efficiency.

In contemporary compressors, the suction valve is normally located at the periphery of the valve assembly. This results in several distinct disadvantages. First, there has to be a passage from the suction valve to the compressing cylinder. The volume of this passage is added to the clearance volume and results in lower volumetric efficiency for the compressor. Obviously, my construction eliminates the above mentioned clearance volume loss since my suction valve 30 is located directly above the piston 12. Also, since the suction valve 30 and suction chamber 26 are located directly above the compression chamber, suction valve passage losses are kept to a minimum. In contemporary compressors the suction gas has to follow a tortuous path before entering the compressing cylinder. Such tortuous path increases the pressure loss and thereby decreases the efficiency of the compressor. My new and improved valve structure places the suction chamber immediately above the suction passages 46 to decrease the amount of pressure drop loss normally present in modern day compressors. Further, contemporary compressors allow the suction gas to be drawn to the compressing cylinder through only one side of the suction valve resulting in high gas velocities and high pressure drop through the suction valve. This result is obtained through the location of the suction valve and passage in conjunction with the stepped suction passage construction. According to the equation that the flow (Q) is equal to the velocity (V) times the cross-sectional area (A), the velocity of the gas through either the suction or the discharge valve will be at a minimum when the entrance or discharge area around the valve is at a maximum. Looking at FIG. 2, it can be seen that suction gas enters the compressing cylinder on all sides of the suction valve 40

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and does have the high pressure drop and high suction gas velocities of contemporary compressors because of the increased suction gas entrance area. To be able to obtain the largest suction gas entrance area and the lowest suction gas velocity, the suction passage 46 is stepped to increase the diameter of the suction valve and thereby the suction gas entrance area to the cylinder. The laminated valve plate 32 allows the use of the stepped suction passage 46 and the stepped discharge passage 44 at a minimum expense of labor and material. Since O-ring 34 is necessary to seal the suction side of the compressor from the discharge side of the compressor, discharge passage 44 is also stepped to provide sufficient discharge passage area with a minimum use of clearance volume and at the same time allow a good seal between the discharge passage 44 and the suction passage 46 by the O-ring 34.

In operation on the suction stroke, gas is drawn into the compressing cylinder 16 via suction conduit 28, muffle chamber 26, suction passage 46, and suction valve 30. It should be noted that recess 52 in shoulder 55 of casing 16 provides a stop means for the suction valve 30 to limit the maximum opening of the suction valve on the suction stroke. Further, recess 52 provides a lead-in on the discharge passages 44. Such lead-in minimizes the pressure drop in the discharge passages as the compressed gas is being fed to the discharge chamber on the compression stroke. Further, recess 52 provides a lead-in for the discharged to discharge chamber 54 via discharge passage 44 and discharge valve 40. The compressed gas from the cylinder as well as any other cylinder in the compressor is manifolded and directed to the point of use.

As set forth above, I have provided a compressor with a valve assembly which is cheaper to produce and provides good entrance conditions, a low pressure drop through the suction valve and passage, low suction gas velocities, improved volumetric efficiencies, and high overall compressor efficiencies.

Although I have described in detail the preferred embodiments of my invention, I contemplate that many changes may be made without departing from the scope or spirit of my invention, and I desire to be limited only by the claims.

I claim:

1. In a reciprocating compressor: a cylinder, means forming a compression chamber in said cylinder, means forming a suction chamber at the top of said cylinder, shoulder means on said cylinder, valve assembly means

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abutting said shoulder means and separating said suction chamber from said compression chamber, said valve assembly means having an annular valve plate abutting said shoulder means and an annular discharge valve cage supported on said valve plate, said valve cage being greater in diameter than said valve plate and forming an annular chamber between said shoulder means and said valve cage, means forming a suction passage on said valve assembly means, means forming a discharge passage in said valve plate, the centerlines of said suction passage being radially closer to the centerline of said cylinder than the centerline of said discharge passage, a suction valve operably associated with said suction passage and adjacent said shoulder, a discharge valve operably associated with said discharge passage to stop passage of gas thru said discharge passage on the suction stroke, means forming a passage adjacent said discharge valve to pass compressed refrigerant to said annular chamber on the compression stroke, recess means in said shoulder means adjacent said suction valve to limit the opening of said suction valve and to direct compressed gas into said discharge passage on the compression stroke, and piston means slidably mounted in said cylinder to draw gaseous fluid thru said suction passage on the suction stroke and to discharge compressed gas into said annular chamber on the compression stroke.

2. The structure of claim 1 wherein said valve plate is laminated and said suction passage and said discharge passage are stepped.

3. The structure of claim 2 wherein the centerline of said discharge passage opening on the compression side of said valve plate is radially closer to the centerline of the cylinder than the centerline of the discharge passage opening in the discharge side of said valve plate.

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