

REFRIGERANT COMPRESSOR

5 The invention is directed to a refrigerant compressor having a cylinder block including a plurality of cylinders and pistons reciprocating in the cylinders and a valve plate assembly.

10 Figure 5 of the accompanying drawings shows a known refrigerant compressor having a cylinder block 11, a front housing 12 and a cylinder head 31. a crank chamber 13 is formed between the front housing 12 and the cylinder block 11. A rotor 14 disposed in the crank chamber 13, is connected to the end of a
15 drive shaft 16, and is rotatably supported on the front housing 12 through a needle bearing 17. The drive shaft 16 is rotatably supported in the front housing 12 through a bearing 15.

20 A ring shaped wobble plate 19 is disposed against an inclined surface 14a of the rotor 14 via a thrust needle bearing 18. A bevel gear 24, fixed to the wobble or swash plate 19, mates with a bevel gear 20b, which includes a cylindrical portion 20. The bevel gears 24 and 20b mate around a steel ball 21
25 which is disposed between them. The cylindrical portion 20 is disposed in a passageway 22 of the cylinder block 11, and is movable in the axial direction but is prevented from rotating. Also, the cylindrical portion 20 is urged towards the bevel
30 gear 24 of the wobble plate 19 by a spring 23. Rotation of the wobble plate 19 is prevented by the gearing of the bevel gear 20b to the bevel gear 24 so that the wobble plate wobbles without rotating.

35 A plurality of cylinders 25 are formed in the cylinder block 11. A piston 26 is slidably disposed in each cylinder 25 and is connected to the wobble plate 19 at its circumference through ball couplings

28 and 28' at the ends of a connecting rod 27. Each ball coupling 28 and 28' is movable in respective socket portions of the wobble plate 19 and respective piston 26.

5 Figures 6, 7, 8 and 9 show a prior valve plate
30 having gaskets 29 and 29' on the surfaces of both
its faces. A cylinder head 31 is fixed to the other
end of the cylinder block 11 by bolts 32, which pass
10 through the valve plate 30 to attach the valve plate
30 between the cylinder block 11 and the cylinder
head 31. A suction chamber 33 is formed along the
perimeter of the cylinder head 31, and a discharge
chamber 34 is formed at the centre portion of the
cylinder head 31. A plurality of suction holes 35
15 are formed through the valve plate 30 to place each
cylinder 25 in fluid communication with the suction
chamber 33. A plurality of discharge holes 36 are
also formed through the valve plate 30 to place each
cylinder 25 in fluid communication with the discharge
20 chamber 34. Gaskets 29 and 29' have openings aligned
with the suction holes 35 and discharge holes 36.

 A suction valve 38 is disposed on the surface
of the valve plate 30 facing the cylinders 25, and a
discharge valve 39 is disposed on the other surface
25 of the valve plate 30. The valve plate 30 is fixed
between the suction valve 38 and discharge valve 39
by a bolt 37, with the valves 38 and 39 resting on
top of the flat surfaces of the valve plate 30. A
plate 40 which backs-up the discharge valve 39 is
30 also attached to the valve plate 30 by the bolt 37.

 The suction valve 38 has a generally
star-shaped configuration with a plurality of points
38', each of which extends over a suction hole 35 to
open and close the respective suction hole. The
35 discharge valve 39 similarly has a generally
star-shaped configuration with a plurality of points
39', each of which extends over a discharge hole 36

to open and close the respective discharge hole.

Since the suction valve 38 and discharge valve 39 are fixed to the valve plate 30 by simply resting against the flat surfaces of the valve plate 30, the valves stack-up to result in a thickness of material above the surfaces of the valve plate 30. On the face of the valve plate 30, which faces the cylinders 25, dead or wasted space D is produced around the border of the suction valve 38 and above the surface of the valve plate 30, as shown in Figure 10. This dead space has no relationship to the change of volume due to the reciprocation of a piston 26, i.e. it reduces compression since it adds volume to the minimum volume at the maximum compression stroke. As a result, the compression efficiency of such a compressor is impaired.

It is the object of the invention to provide a valve and valve plate for a refrigerant compressor which improves compression efficiency.

According to the invention, a refrigerant compressor comprises a front housing; a cylinder block having a ring of cylinders; a cylinder head having a suction chamber and a discharge chamber; a drive shaft supported by the front housing; a plurality of pistons, a respective one of which is disposed in each of the cylinders and drivingly coupled to the drive shaft for reciprocating motion; a valve plate located between the cylinders and the cylinder head, the valve plate having a suction hole and a discharge hole at each of the cylinders for placing each of the cylinders in fluid communication with the suction and discharge chambers; and a suction valve extending over each of the suction holes to open and close the suction holes, the valve plate having a recess formed in its surface facing the pistons, the recess having substantially the same shape and depth as the suction valve to receive the

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parts of the suction valve in the recess during the compression strokes of the pistons in adjacent cylinders.

5 The invention will now be described by way of example with reference to the accompanying drawings, in which:-

10 Figure 1 is an axial elevational view of the face facing a cylinder block of a valve plate and a suction valve of a compressor in accordance with the invention;

Figure 2 is similar view of the face facing a cylinder head of the valve and a discharge valve;

15 Figure 3 is an axial sectional view of the valve plate, suction valve and discharge valve of Figures 1 and 2;

Figure 4 is an enlarged sectional view of a part of a compressor in accordance with the invention illustrating the relationship between a piston and the valve plate and suction valve during compression;

20 Figure 5 is a sectional view of a refrigerant compressor of the kind with which the invention is concerned;

25 Figure 6 is an axial elevational view of the face facing the cylinder block of the valve plate and suction valve of a prior compressor of the kind shown in Figure 5;

Figure 7 is a view similar to Figure 5 but of the face facing the cylinder head of the valve plate and a discharge valve;

30 Figure 8 is an axial sectional view of the valve plate shown in Figures 6 and 7;

Figure 9 is a view corresponding to Figure 4, but of the prior compressor; and,

35 Figure 10 is an enlarged elevational view of a part of the prior compressor illustrating the suction valve and a gasket.

Since the general construction of the

compressor according to the invention is the same as that of the compressor already described with reference to Figure 5, only the construction of the improved valve plate and suction valve according to the invention will be described.

Referring to Figures 1 to 4, reference numbers with the suffix A are used to indicate parts of the compressor in accordance with the invention corresponding to parts with the same reference numbers in Figures 5 to 10. As shown, the valve plate 30A has a recess 1A formed in its surface which faces the pistons 26A. The suction hole 35A and the discharge hole 36A are formed through the valve plate 30A to place the cylinder 25A in fluid communication with the suction chamber 33A and the discharge chamber 34A. The recess 1A has approximately the same shape as the generally star-shaped suction valve 38A and its size is approximately the same as or slightly larger than that of the suction valve 38A. The depth of the recess 1A is the same as or slightly deeper than the thickness of the suction valve 38A. Thus, the outer surface of the suction valve 38A extends generally flush with the remainder, i.e. all but the recess 1A, of the surface of the valve plate 30.

The suction valve 38A is fixed to the surface of the valve plate 30A, which faces the piston 26A, and in alignment with the recess 1A, by the bolt 37A. The discharge valve 39A and plate 40A are also fixed to the valve plate 30A on its opposite surface by the bolt 37A. An elongate hole 42A is formed through the suction valve 38A at the position corresponding to each discharge hole 36A in the valve plate 30A. When the suction valve 38A is closed during compression, compressed fluid passes to the discharge chamber 34A through the elongate hole 42A. The small hole 41A is used to determine relative

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positioning between the valve plate 30A, cylinder block 11A and cylinder head 31A.

By placing the suction valve 38A in the recess 1A of the valve plate 30A, and not extending above the surface of the valve plate 30A, dead space D between the piston 26A and valve plate 30A is minimized, since dead space between the border of the suction valve and the outer surface of the valve plate is absent. As a result, the efficiency of the compressor is improved.

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CLAIMS

1. A refrigerant compressor comprising a front housing; a cylinder block having a ring of cylinders; a cylinder head having a suction chamber and a discharge chamber; a drive shaft supported by the front housing; a plurality of pistons, a respective one of which is disposed in each of the cylinders and drivingly coupled to the drive shaft for reciprocating motion; a valve plate located between the cylinders and the cylinder head, the valve plate having a suction hole and a discharge hole at each of the cylinders for placing each of the cylinders in fluid communication with the suction and discharge chambers; and a suction valve extending over each of the suction holes to open and close the suction holes, the valve plate having a recess formed in its surface facing the pistons, the recess having substantially the same shape and depth as the suction valve to receive the parts of the suction valve in the recess during the compression strokes of the pistons in adjacent cylinders.

2. A compressor according to claim 1, wherein the suction valve and recess each has a generally star-shaped configuration with a plurality of points, each of the points extending over a respective one of the suction holes.

3. A refrigerant compressor, substantially as described with reference to Figures 1 to 5 of the accompanying drawings.

