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REFRIGERANT COMPRESSOR

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5 The present invention relates to a refrigerant compressor, and more particularly to the structure of a discharge portion of the compressor.

 There are many types of refrigerant compressors, for example a reciprocating type of
10 compressor, which compresses fluid by reciprocating motion of pistons, is generally well known. Compressed fluid is finally discharged to the circuit outside the compressor through a discharge portion.

 In conventional reciprocating type compressors,
15 when fluid is compressed by the reciprocating motion of the pistons, pulsation of the discharged fluid occurs, and this pulsation is transmitted to the refrigerant circuit. As a result, loud noise is caused by the pulsation.

20 On the other hand a compressor for an automobile air conditioning system is generally driven by the engine of the automobile. Accordingly, the rotational speed of the compressor is varied in accordance with the change of engine speed, which
25 corresponds to the cruising condition of the automobile. Thus, the discharge volume of the fluid from the compressor is changed with the speed of the engine. When the car is driven at high speed, the discharge volume of the refrigerant may exceed the
30 required volume, and if the discharge volume of compressed refrigerant exceeds this volume, the efficiency of the heat exchanging in the air conditioning system is impaired.

 It is a primary object of this invention to
35 provide a refrigerant compressor, with low pulsation of discharged fluid, whilst controlling excessive refrigerating performance at high rotational speeds

thereof.

In accordance with the invention, in a refrigerant compressor having a housing including a cylinder block, cylinders formed in the cylinder block, a front housing at one end of the housing, a drive shaft rotatably supported by the front housing, a cylinder head disposed on the other end of the housing, a suction port provided on the cylinder head to connect a suction chamber formed in the cylinder head, in use, with a refrigerant circuit, and a discharge portion provided on the cylinder head to connect a discharge chamber formed in the cylinder head, in use, with the refrigerant circuit; wherein the discharge portion provides an elongate fluid outlet duct leading from the discharge chamber and comprising two coaxial passages in series, the cross sectional area of the one of the passages being smaller than that of the other passage to provide a nozzle portion.

The axial length of the one passage is generally much shorter than that of the other passage, so that the nozzle portion provides an orifice or throttle, constricting the flow out of the discharge chamber to the refrigerant circuit.

With the arrangement according to the invention, the pulsation of compressed fluid may be controlled while the fluid passes through the discharge portion. Also, the volume of discharged fluid may be controlled by the discharge portion thereby to improve the durability of the compressor.

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

Figure 1 is a cross sectional view of a reciprocating type refrigerant compressor in accordance with this invention;

Figure 2 is a graph illustrating the pulsation decreasing rate of discharge pressure and decreasing

rate of refrigerating performance according to the cross sectional area of the nozzle portion; and,

Figures 3 to 5 are cross sectional views of modified discharge portions.

5 Figure 1 shows a reciprocating type refrigerating compressor, which comprises a cylindrical housing 10 including a cylinder block 11 having a plurality of axial cylinders, a front housing 13, and a cylinder head 14.

10 The interior of the cylinder housing 10, which is defined between the cylinder block 11 and front housing 13, functions as a crank chamber 15. A rotor 16, which is disposed within the crank chamber 15, is fixedly mounted on an inner end portion of a drive
15 shaft 17. The drive shaft 17 extends through a central portion of the front housing and is rotatably supported therein through a needle bearing 18. The rotor 16 is also supported on an inner surface of the front housing 13 through a thrust needle bearing 19.
20 A wobble plate 20 is disposed on an inclined surface 16a of the rotor 16 through a thrust needle bearing 21, and is non-rotatably supported on a steel ball 22 seated on an end of a supporting member 23.

 The supporting member 23 comprises a shank
25 portion 23a having an axial bore 23b at the other end thereof and a bevel gear 23c at the end of the shank portion 23a which has a seat for the steel ball 22 at the centre thereof. The supporting member 23 is axially slidable but non-rotatably supported, within
30 the cylinder block 11 by insertion of the shank portion 23a into the axial bore 24 formed in the cylinder block 11. Rotation of the supporting member 23 is prevented by a key groove 25 and key (not shown). A coil spring 26 is disposed in the axial
35 bore 23b of the supporting member 23, and the outer end of the spring 26 is in contact with a screw member 27, so that the shank portion 23a is urged

5 towards the wobble plate 20. The bevel gear portion 23c of the supporting member 23 engages with a bevel gear 28 mounted on the wobble plate 20 so that the rotation of the wobble plate 20 is prevented. The steel ball 22 is seated in the seat formed at the central portion of the bevel gear 28, so that the wobble plate 20 may be nutatably, but non-rotatably, supported on the steel ball 22.

10 The cylinder block 11 is provided with a plurality of axial cylinders 12 formed therein, within which pistons 29 are slidably and closely fitted. Each piston 29 is connected to the wobble plate 20 through a piston rod 30. The connection
15 between the wobble plate 20 and one end of each piston rod 30, and the connection between the respective piston 29 and other end of the piston rod 30, are by ball joints.

20 On the other end of the cylinder block 11, the cylinder head 14 is secured by bolts 31, which penetrate through a valve plate 32 and two gasket elements (not shown). The interior of the cylinder head 14 is divided into two chambers, a suction chamber 33 and a discharge chamber 34, by an inner
25 partition wall 13a. A fluid inlet port 35, which has an axial hole 351 is formed on the outer peripheral portion of the cylinder head 14 to interconnect the suction chamber 33 and a refrigerant circuit. A fluid outlet or discharge portion 36, which comprises
30 first and second passages in series is positioned at the central portion of the cylinder head 14 to interconnect the discharge chamber 34 and the refrigerant circuit. The inner diameter of the first passage 361, which is downstream of, is greater than that of, the second passage 362, i.e. the discharge
35 portion provides a nozzle portion.

Figure 2 shows, in curve A, the relationship between pulsation decreasing rate and opening area of

18 the nozzle portion, and also, in curve B the relationship between the decreasing rate of refrigerating capacity and the opening, i.e. cross sectional, area of the nozzle portion.

5 As shown by curve A, the pulsation decreasing rate is decreased in proportion to the increase of the opening area of nozzle portion 362, i.e. the pulsation is gradually decreased with increase of opening area of the nozzle portion 362. On the other
10 hand, as shown by curve B, the decreasing rate of refrigerating capacity is decreased with increase of the opening area of the nozzle portion 362. In consideration of the result of the test shown in Figure 2, the opening area of the nozzle portion 362
15 should be selected around 16 mm.

Figure 3 shows another example in which an axial passage 381 is formed through the central portion of the cylinder head 38 to function as a discharge port, and a separately formed discharge
20 element 37 is fastened on the outer surface of the cylinder head 38 by bolts (not shown) to communicate with the passage 381. An O-ring 373 is disposed between the cylinder head 38 and the discharge element 37 to seal therebetween. The discharge
25 element 37 is provided with passages of different diameter in series, i.e. a first passage 372, which communicates with the part 381, has a smaller diameter than that of a second passage 371. Thus, the first passage 372 functions as the nozzle
30 portion. In the above-mentioned construction the discharge element can easily be replaced so that the inner diameter of the nozzle portion can be selectively changed.

Figure 4 shows a further modification of
35 connection between the discharge port and the refrigerant circuit. A nipple element 39 is sealed on the outer end of a discharge port 40, which is

integrally formed with a cylinder head 41, by a securing clamp 42. The nipple element 39 is connected between the outlet port 40 and a rubber hose 43. The inner diameter of an axial passage 391 in the nipple element 39 is equal to that of the discharge port 40. A nozzle portion 392 is formed at the outer opening end of the nipple element 39. In the above-mentioned construction, also, the inner diameter of the nozzle portion can easily be changed by replacing the nipple element 39.

Figure 5 shows yet a further modification in which a conduit element is disposed on the inside of a discharge port 45. A nozzle portion 441 is formed at the inner end of the conduit element 44. In this construction, the conduit element 44 is removably disposed in the discharge port. The axial hole 441 may alternatively be formed on the outer end of the conduit element 44.

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CLAIMS

1. A refrigerant compressor having a housing including a cylinder block, cylinders formed in the cylinder block, a front housing at one end of the housing, a drive shaft rotatably supported by the front housing, a cylinder head disposed on the other end of the housing, a suction port provided on the cylinder head to connect a suction chamber formed in the cylinder head, in use, with a refrigerant circuit, and a discharge portion provided on the cylinder head to connect a discharge chamber formed in the cylinder head, in use, with the refrigerant circuit; wherein the discharge portion provides an elongate fluid outlet duct leading from the discharge chamber and comprising two coaxial passages in series, the cross sectional area of the one of the passages being smaller than that of the other passage to provide a nozzle portion.
2. A compressor according to claim 1, wherein the passages are formed in an element formed separately from the cylinder head.
3. A compressor according to claim 1 or claim 2, wherein the one passage is upstream of the other passage.
4. A compressor according to claim 1 or claim 2, wherein the discharge portion includes a discharge port formed on the cylinder head and a nipple element disposed on the outer end of the discharge port, the nozzle portion being provided by the nipple element.
5. A compressor according to any one of claims 1 to 3, wherein the discharge portion includes a discharge port formed on the cylinder head and a



conduit element disposed in the discharge port, the nozzle portion being provided at an end of the conduit element.

- 5 6. A refrigerant compressor, substantially as described with reference to any one of the examples illustrated in the accompanying drawings.

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