

RECIPROCATORY PISTON COMPRESSOR FOR SMALL
REFRIGERATING MACHINES AND ASSEMBLY METHOD THEREFOR

The present invention relates to reciprocatory piston compressors for small refrigerating machines and an assembly method for the connecting rod used in such compressor.

The prior art compressors of this type have a connecting rod comprising a first and a second eye, the first eye being connected by means of a wrist pin to the reciprocatory piston, and the second being connected to a crank pin which is on one end of a crankshaft. This crankshaft is orthogonal to the piston stroke and supports at the other end the rotor of an electric motor. The motor stator is supported on a crankcase that includes a crankshaft bearing portion, a cylinder, a suction and a discharge muffler. This crankcase is mounted within an outer housing by means of coil springs and this outer housing is closed with the top portion forming a hermetically sealed unit. Because of the small size of the parts and reduced space for mounting the piston, connecting rod and crank pin assembly, a number of different constructions for mounting this assembly have been proposed. Thus Brazilian Patent Specification No. 4832/73/BR discloses an arrangement wherein a bushing is press fitted between the second eye of the connecting rod and the crank pin. To permit assembling, the second eye of the connecting rod has an inside diameter larger than the crank pin, with the clearance between them filled in by the bushing.

Besides making assembly somewhat difficult, this solution also requires additional parts.

Brazilian Patent Specification PI 8103673/BR and European Specification No. 0046142 disclose the solution of a slot extending through the cylinder wall so as to permit the connecting rod and the wrist pin to be inserted in this piston during the assembly. This slot in the cylinder wall suffers the disadvantage of reducing its stiffness, causing dimensional deviations during cylinder machining.

Another possible solution is shown in Brazilian Patent Specification PI 8204474/BR, wherein the crankshaft and crank pin are constructed in two separate pieces connected during assembly which is difficult. This solution requires the provision of additional parts to achieve the assembly of the crank pin to the crankshaft.

There is also the possibility of disposing the crankcase and the crankshaft bearing portion in two separate parts, which are assembled at the same time that the connecting rod is inserted over the crank pin, after the piston, crank pin and connecting rod assembly is in its proper place. This solution presents the same disadvantages of that mentioned before.

Patent Specification DE 3123708 A1 proposes a connecting rod with a head formed in two parts, which are connected by means of specially designed clamps.

This construction presents as disadvantages the high number of components for a part which should be simple in principle, besides keeping in movement an excessively increased mass.

Finally, Brazilian Patent Specifications PI 8006896/BR and PI 8201683/BR propose connecting rods with two-piece rods, so that these two pieces can be connected together by means of joints, usually employing pins. As in the aforementioned solution, this arrangement requires also the provision of additional parts, which increase the costs of the product, make its assembly difficult and increase the reciprocating mass.

An object of the present invention is to provide a two-piece connecting rod, arrangement of the type comprising a two part rod, that permits easy mounting of the piston, connecting rod and crank pin assembly without requiring the provision of additional connecting parts, which would increase the cost of the product, increase its mass and make its assembly difficult.

According to the invention there is provided a reciprocatory piston compressor for a refrigerating machine, of the type including a connecting rod with its first eye connected to the compressor piston by means of a wrist pin and connected with its second eye to the crank pin of a crankshaft, wherein the said second eye of the connecting rod includes a radial projection provided with a longitudinal slot extending at least over part of the thickness of the radial projection and presenting at least two internal end faces and two opposed lateral faces, its first eye being provided with a lengthened radial projection defining the rod of the connecting rod and having its end portion formed with at least two end faces and two opposite lateral faces and fitted in the slot of the second eye, the axial distance between the centres of the eyes being defined by the contact between two surfaces of the end portion of the rod and two corresponding stop surfaces of the projection of the second eye, the corresponding adjacent lateral faces of the slot of the radial projection of the second eye and the rod being fastened together to maintain the geometrical axes of the two eyes coplanar.

Preferably, the fastening between the adjacent lateral faces of the slot and the rod is accomplished by metallic bonding or glueing after the two pieces have been brought into a position of direct contact between the stop faces of the slot and the rod and then held in the desired relative position. The bonding can be carried out by brazing or braze-welding, preferably by high frequency, providing a very short heating time and avoiding deformations. It can be carried out also through application of suitable adhesives.

The invention ensures in an advantageous way, rigid joint between the two pieces of the connecting rod without using additional parts while guaranteeing the integrity of the system. The reduced mass contributes to lowering the vibration level of the unit and the possible assembly procedure enables automatising the assembly operations.

The invention will now be described in more detail by way of example with reference to the drawings, in which :

Figure 1 shows a fragmentary diagrammatic longitudinal section through a sealed compressor with reciprocating piston, according to the present invention;

Figure 2 shows on a larger scale a part of Figure 1, illustrating the dismounted connecting rod and piston before assembly in the cylinder of the compressor.

Figure 3 shows an exploded top view of the two pieces of the connecting rod prior to fastening by welding or glueing, and

Figure 4 shows on a larger scale a top view of the joint between the two pieces of the connecting rod shown in Figure 3.

Referring to Figure 1, the motor-compressor unit is suspended within a housing 3 by means of coil springs 2 (only one is shown). A crankcase 4 serves as support for mounting the stator 5 of the electric motor and includes a bearing portion 6 for supporting the crankshaft 7 on which is mounted in the lower section the rotor 8 of the motor. The crankcase 4 further includes a cylinder 9, inside which reciprocates the piston 10. The crankshaft 7 has on its upper end a crank pin 11 having a free upper end 12.

As can be seen in Figures 1 and 2, the cylinder 9 carries at its closed end opposite the crankshaft a valve plate 17 and a cylinder head 18 of conventional construction. The connecting rod shown in Figures 3 and 4 comprises two parts 20 and 30 and connects the piston 10 to the crank pin 11 of the crankshaft 7, as shown in Figure 1.

The first part 20 of the connecting rod comprises the first eye 21 from which extends a lengthened radial projection 22, which defines the rod of the connecting rod, this first eye 21 being connected to the piston 10 by a wrist pin 15.

The second part 30 of the connecting rod comprises the second eye 31 from which extends a short radial projection 32 provided with a longitudinal slot 33, this second eye 31 being engaged over the crank pin 11 of the crankshaft 7.

In the arrangement shown in Figures 3 and 4, the slot 33 of the second eye 31 extends over the whole thickness of the small projection 32, presenting two opposite and parallel lateral faces 34 and two "V" shaped internal end faces, with its vertex provided with an indentation 36. This is to avoid the surface finishing of the slot 33 having any interference in the fitting of the two parts 20 and 30 of the connecting rod. In this arrangement, the end portion 27 of the rod 22 linked to the first eye 21 presents two faces 25 forming a "V" with a somewhat rounded vertex, these faces being dimensioned to permit full contact with the respective internal end walls 35 of the slot 33.

This "V" shaped fitting eliminates undesirable transverse deviations in this kind of part, providing a self-aligning fitting which will keep the correct axial distance between the first and second eyes besides keeping its geometrical axes coplanar during the fastening operation (to be explained later) without needing additional external devices to control the relative position between the two pieces of the connecting rod during assembly.

In this arrangement the width A1 of the end portion of the rod 22 is slightly smaller than the width A2 of the slot 33 so as to provide a small clearance between the lateral faces 34 of the slot 33 and the adjacent walls 24 of the end portion 27 of the rod 22. This small clearance does not impair the relative position of the two parts, because of the "V" shaped fitting of the end walls, and it ensures the relative axial fastening between the two pieces, carried out by a welding operation by brazing or braze-welding, or by soldering, hard soldering or glueing the adjacent lateral walls of the two pieces, thereby filling in the space therebetween.

The assembly procedure for the construction shown in Figures 3 and 4 will be described next, Figure 2 being observed for a better understanding.

The crankshaft 7 is introduced into the bearing portion 6 through the upper side of the crankcase 4. The second eye 31 of the connecting rod is then inserted over the crank pin 11. With the valve plate 17 and cylinder head 18 removed, the assembly formed by the first eye 21 of the connecting rod, the piston 10 and the wrist pin 15 already assembled, is introduced into the cylinder 9 through the outer end 19. This assembly is then moved toward the other part of the connecting rod at the same time that it can be turned in the cylinder so as to permit proper connection of the parts 20 and 30 of the connecting rod. A punch (not illustrated) also introduced through the cylinder 9 by the free end 19, presses lightly the piston head 10 against the crank pin 11, which is in the position corresponding to bottom dead centre. In this way, the end portion of the rod 22 is kept correctly fitted inside the slot 33, while the welding or glueing of the parts is performed.

The type of fitting shown here allows for full transmission of force through the connecting rod, with a high level of reliability while permitting assembly in constricted space conditions.

C L A I M S

1. A reciprocatory piston compressor for a refrigerating machine, of the type including a connecting rod with its first eye connected to the compressor piston by means of a wrist pin and connected with its second eye to the crank pin of a crankshaft, wherein the said second eye (31) of the connecting rod includes a radial projection (32) provided with a longitudinal slot (33) extending at least over part of the thickness of the radial projection (32) and presenting at least two internal end faces (35) and two opposed lateral faces (34), its first eye (21) being provided with a lengthened radial projection (22) defining the rod of the connecting rod and having its end portion (27) formed with at least two end faces (25) and two opposite lateral faces (24) and fitted in the slot (33) of the second eye (31), the axial distance between the centres of the eyes (21, 31) being defined by the contact between two surfaces (25) of the end portion (27) of the rod (22) and two corresponding stop surfaces (35) of the projection of the second eye (32), the corresponding adjacent lateral faces (34, 24) of the slot of the radial projection of the second eye (32) and the rod being fastened together to maintain the geometrical axes of the two eyes (21, 31) coplanar.

2. A compressor according to claim 1, characterised in that the contact of the said end faces (35) of the rod (22) with the corresponding end faces (33) of the slot (33) ensures that the geometrical axes of the eyes (21, 31) are coplanar.

3. A compressor according to claim 2, characterised in that the end faces of the slot (33) of the radial projection of the second eye (31) are defined by two faces forming a "V", the end faces (25) of the rod (22) being also forming a "V" shape and being in contact with the two end faces (35) of the slot (33),

4. A compressor according to any one of claims 1 to 3, characterised in that the width (A1) of the end portion (27) of the rod (22) is smaller than the width (A2) of the slot (33), so as to



define a clearance between the lateral walls (24, 34) of the rod (22) and the slot (33), and the fastening between the adjacent lateral faces (24, 34) of the end portion (27) of the rod (22) and the slot (33) is accomplished by filling at least partially the said clearance with a bonding material.

5. A reciprocatory piston compressor for a refrigerating machine, substantially as described with reference to the drawings.

6. A method of assembling a reciprocatory piston compressor for a refrigerating machine as claimed in any of the preceding claims comprising the steps of :

mounting the piston (10) to the part of the connecting rod defined by the rod (22) and the first eye (21);

introducing the rod (22), first eye (21) and piston (10) assembly into a cylinder (9) of the compressor through the outer end of the cylinder,

mounting the second eye (31) of the connecting rod on the crank pin (11) of the crankshaft (7), placing its radial projection (32) axially aligned with the cylinder (9);

pressing the piston (10) toward the crankshaft (7) in order to make contact between surfaces (25, 35) thereby defining the distance between the axes of the first and second eyes (21, 31) and holding the axial alignment and the coplanar disposition between the two eyes of the connecting rod and

maintaining this position during fastening between the lateral walls (24, 34) of the end portion of the rod (22) and the slot (33).

7. A method according to claim 6, characterised in that the said fastening is accomplished by the application of a binding material between the lateral walls (24, 34) of the rod and the slot.

8. A method according to claim 7, characterised in that the binding material is brazing, braze-welding, hard soldering, or glueing material or solder.

