

SPECIFICATION

SYO-9603

TITLE OF THE INVENTION

MULTISTAGE COMPRESSOR

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to a multistage compressor for compressing predetermined gas with high pressure at multiple stages, more particularly to a multistage compressor comprising a yoke and a cross slider
10 wherein the yoke and the cross slider are not damaged even if the temperature rises in use and the dimensions of the members are changed due to thermal expansion.

2. Background Art

15 The constitution of this type of apparatus wherein as the number of compressing stages is increased, the diameter of a cylinder and a piston is thinned more in a reciprocatively compressing section, that is, a compressing section by a cylinder and a piston to which higher pressure
20 is applied, the reciprocatively compressing sections are arranged in the shape of L, V, W, a half star, a star and a balanced opposed type and a mechanism for performing a compressing operation at multiple stages by being interlocked with a crankshaft so that each compressing section is
25 operated at a stroke shifted by a required phase is operated



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by a driving source such as a motor is disclosed in Figs. 30 to 32 in Volume 10 of "Mechanical Engineering Handbook" published on Sep. 15 in 1970 by Japan Society of Mechanical Engineers (JSME).

5 A multistage compressor wherein four reciprocatively compressing sections 101, 102, 103 and 104 are arranged so that they are reciprocated on perpendicular axes 105 and 106 as shown in Fig. 4, higher pressure is applied to the reciprocatively compressing sections 101-104
10 in order and the reciprocatively compressing section 104 is the last stage of high pressure compressing sections is well-known in, for example U. S. patent No. 5033940.

 In the above-described multistage compressor, a pair of opposite pistons 51 and 53 are coupled onto a yoke 1A
15 and a cross slider 2A provided in the yoke 1A so that the cross slider 2A can be moved across the axis 106 is coupled to a crankshaft 4 via a crank pin 3. The other pair of opposite pistons 52 and 54 are coupled onto a yoke 1B arranged in a state in which the yoke 1A is rotated by 90
20 degrees and a cross slider (not shown) provided in the yoke 1B so that the cross slider can be moved across the axis 105 is also coupled to the crankshaft 4 via the crank pin 3.

 Therefore, when the crankshaft 4 is rotated by an electric motor (not shown) and so on and the crank pin 3 is
25 rotated around the crankshaft 4, the cross slider 2A is moved



by the displacement of the crank pin 3 in the direction of the axis 105 in the yoke 1A, the yoke 1A is moved in the direction of the axis 106 and therefore, a pair of pistons 51 and 53 are reciprocated only in the direction of the axis
5 106.

In the meantime, the cross slider (not shown) is moved in the direction of the axis 106 in the yoke 1B, the yoke 1B is moved in the direction of the axis 105 and therefore, a pair of pistons 52 and 54 are reciprocated only
10 in the direction of the axis 105.

As a cross slider 2 is required to be slid naturally in a yoke 1 so as to obtain smooth reciprocation of the pistons 51, 52, 53 and 54 by converting rotational movement of the crankshaft 4, a pair of rolling bearings 5
15 are arranged between the yoke 1 and the cross slider 2 as shown in, for example Fig. 5.

However, in the multistage compressor constituted as described above, as gas is compressed in an adiabatic state, the temperature of the members thereof rises up to 120
20 to 130°C and the dimensions of the members are altered even if the members are cooled by a cooling fan and so on.

That is, if, for example a yoke is formed by aluminum or an aluminum alloy and a cross slider which is readily worn is formed by a steel for lightening, a gap
25 between the yoke and the cross slider is widened due to the

difference between them in an expansion coefficient in use.

Therefore, if the rolling bearing is designed so that it normally functions around ordinary temperature, the gap described above is widened too much when the temperature rises and a problem that sliding to which great frictional force is applied partly occurs and that a cross slider and a yoke are remarkably damaged because the rolling bearing is displaced occurs.

In the meantime, if the rolling bearing is designed so that it normally functions when the temperature rises, the gap described above is too narrow because the temperature is not high enough when the compressor is started, extremely great force is applied to the rolling bearing, the rolling bearing cannot function normally, in this case a problem that a cross slider and a yoke are remarkably damaged also occurs and the constitution which can bear the change of temperature is required.

SUMMARY OF THE INVENTION

The present invention is made to solve the above-described problems in the prior art and the object is to provide a multistage compressor comprising at least a pair of opposite pistons, a crankshaft and a Scotch yoke mechanism for fixing the piston, said Scotch yoke mechanism comprising a yoke and a cross slider, wherein reciprocation of the



pistons is obtained by converting rotation of the crankshaft by the Scotch yoke mechanism, characterized in that a pair of rolling bearings and liner plates are arranged between said yoke and said cross slider and said rolling bearings are
5 pressed toward the cross slider or toward the yoke by springy force generated by spring mechanisms received via said liner plates.

According to the present invention, the problems that the yoke and the cross slider are damaged when the
10 temperature rises in use and the dimensions of the members are changed due to thermal expansion can be solved.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an explanatory view showing the main part
15 according to an embodiment of the present invention;

Fig. 2 is an exploded explanatory view of Fig. 1;

Fig. 3 is an explanatory view showing the main part according another embodiment of the present invention;

Fig. 4 is an explanatory view showing the prior
20 art; and

Fig. 5 is an explanatory view showing a Scotch yoke mechanism.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

25 Referring to Figs. 1 to 3, embodiments according to



the present invention will be described in detail below.

However, as in these drawings a part shown with the same reference number as in Figs. 4 and 5 described above has the same function as that described in the item of the prior art, explanation of such a part is omitted as long as omission does not prevent the present invention from being understood.

In a multistage compressor according to the present invention, a pair of rolling bearings 5 for assisting a cross slider 2 to slide in a yoke 1 are pressed on both sides of the cross slider 2 as shown in, for example Figs. 1 and 2 by springy force generated by springs 7 received via each liner plate 6 made of metal, for example steel.

The yoke 1 is provided with piston mounting holes 11 pierced so that grease can be injected therethrough in the center (grease is injected when a piston is not mounted) and is constituted with, for example two yoke members 1C in the shape of a bowl put opposite so that the cross slider 2, the rolling bearings 5, the liner plates 6 and the springs 7 can be readily housed inside.

In this case, the yoke 1 is constituted so that two yoke members 1C can be integrated by, for example passing bolts 8A through bolt holes 12 provided by piercing the part in which the yoke members 1C are put opposite and fastening nuts 8B onto the screws of these bolts, however, if a positioning concave portion 13 is provided in a plurality of



positions on each end face on which the yoke member are put opposite and a pin 9 is inserted into the concave portion, the yoke members 1C can be readily integrated.

Each concave portion 14 is deep enough to house the entire thickness of each of the liner plates 6 and only the face of the rolling bearing 5 opposite to the liner plate 6 so that the face of the rolling bearing 5 opposite to the cross slider 2 can be protruded from the concave portion is formed inside each yoke member 1C in the shape of a bowl so that even if the cross slider 2 is slid, the rolling bearing 5 and the liner plate 6 are not moved.

At least two concave portions 15 for positioning by inserting springs 7 are disposed in the position equally far from the center of each concave portion 14 in the direction in which the cross slider 2 is slid so that even if the cross slider 2 is slid, the force generated by the spring 7 equally operates on the rolling bearing 5.

The multistage compressor according to the present invention may be constituted so that the rolling bearing 5 is pressed on the inner face of the yoke 1 as shown in Fig. 3 by the force generated by the spring 7 received via the liner plate 6. However, in Fig. 3 an exploded view of the yoke 1 is not shown.

In this case, a concave portion 14A being deep enough to protrude the face of the liner plate 6 on the side



opposite to the rolling bearing 5 is respectively formed on both sides of the cross slider 2 so that even if the cross slider 2 is slid, the liner plate 6 is not moved and at least two concave portions 15A for positioning by inserting the
5 springs 7 are disposed in the position equally far from the center of each concave portion 14A so that even if the cross slider 2 is slid, the force generated by the spring 7 equally operates on the rolling bearing 5.

A concave portion 14B deep enough to protrude the
10 face of the rolling bearing 5 on the side opposite to the cross slider 2 is also formed opposite inside the yoke 1 so that even if the cross slider 2 is slid, the rolling bearing 5 is not moved readily. In this case, a piston mounting hole 11A is not pierced.

15 As described above, as a multistage compressor according to the present invention is constituted so that the rolling bearing 5 is respectively pressed on both sides of the cross slider 2 or on the inner face of the yoke 1 by springy force generated by the spring 7 received via the
20 liner plate 6, the force by which the rolling bearing 5 is pressed on the cross slider 2 or the yoke 1 is unchangeable even if the yoke 1 is formed by, for example aluminum, an aluminum alloy and others to lighten it, the cross slider 2 which is readily worn is formed by steel and the dimensions
25 of the members is changed due to the change of temperature in

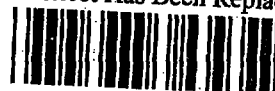


use. Therefore, the function of the rolling bearing 5 can be secured and the degree in which the yoke 1 and the cross slider 2 are worn is greatly reduced.

The present invention is not limited to the above-
5 described embodiments and a variety of transformations may be taken in the range in which they do not deviate from the object described in the claims.

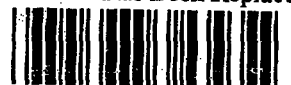
For example, for the spring 7 a plate spring may be used in place of a helical spring and four concave portions
10 15 may be provided to each concave portion 14 or 14A so that the rolling bearing 5 can be pressed by four springs more equally.

As described above, as the multistage compressor
15 according to the present invention is constructed so as that a pair of rolling bearings and liner plates are arranged between said yoke and said cross slider and said rolling bearings are pressed toward the cross slider or toward the yoke by springy force generated by spring mechanisms received
20 via said liner plates, the force by which a rolling bearing is pressed on a cross slider or a yoke is unchangeable even if a yoke is formed by, for example aluminum, an aluminum alloy and others to lighten it, a cross slider which is readily worn is formed by steel and the dimensions of the
25 members are changed due to the change of temperature in use.



Therefore, the function of a rolling bearing can be secured and the degree in which a yoke and a cross slider are worn can be greatly reduced.

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WHAT IS CLAIMED IS:

1. A multistage compressor comprising at least a pair of opposite pistons, a crankshaft and a Scotch yoke mechanism for fixing the piston, said Scotch yoke mechanism comprising
5 a yoke and a cross slider, wherein reciprocation of the pistons is obtained by converting rotation of the crankshaft by the Scotch yoke mechanism, characterized in that a pair of rolling bearings and liner plates are arranged between said yoke and said cross slider and said rolling bearings are
10 pressed by springy force generated by spring mechanisms received via said liner plates.

2. A multistage compressor according to claim 1, wherein said rolling bearings are pressed toward the cross slider by
15 springy force generated by spring mechanisms received via said liner plates.

3. A multistage compressor according to claim 1, wherein said rolling bearings are pressed toward the yoke by springy force
20 generated by spring mechanisms received via said liner plates.

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