United States Patent

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[31] **835,185/69**

[54] **CRANK GEARING WITH A SPECIAL CROSSHEAD FOR HIGH PRESSURE RECIPROCATING COMPRESSORS**
5 Claims, 4 Drawing Figs.

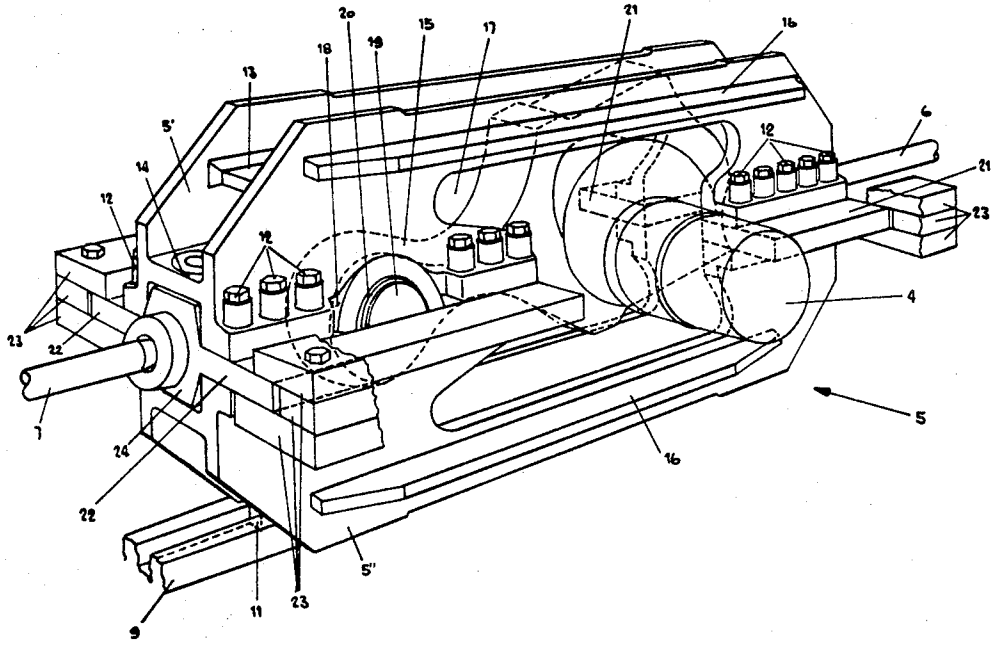
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[51] **Int. Cl.** **F16h 21/22**
[50] **Field of Search** 230/185, 192, 214; 103/171, 184; 74/44; 417/521, 273

[56] **References Cited**
UNITED STATES PATENTS

1,432,041	10/1922	Scott	103/171
1,620,870	3/1927	Carrey	230/192X
2,236,853	4/1941	Herzmark	230/185
2,404,079	7/1946	Manicalco et al.	230/185

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ABSTRACT: A crosshead frame structure is formed from two identical elongated rigid frame sections, each having spaced sidewalls interconnected by spacing blocks at the opposite ends thereof and reinforced by longitudinally extending ribs. The frame sidewalls enclose a connecting rod and have openings for rotatably mounting the connecting rod gudgeon and accommodating the movement of a crankshaft connected to the connecting rod. A pair of plate members mounted between the frame sections on either side of the crankshaft opening serve to mount a pair of piston rods and further include wing portions in a horizontal plane containing the motion axis of the piston rods. Also, a pair of vertical plate portions are mounted to the lower frame section of the crosshead in a vertical plane containing the motion axis of the piston rods. Corresponding horizontal and vertical guide means secured to the housing for the crosshead guide the crosshead structure in horizontal and vertical planes containing the motion axis of the piston rods.



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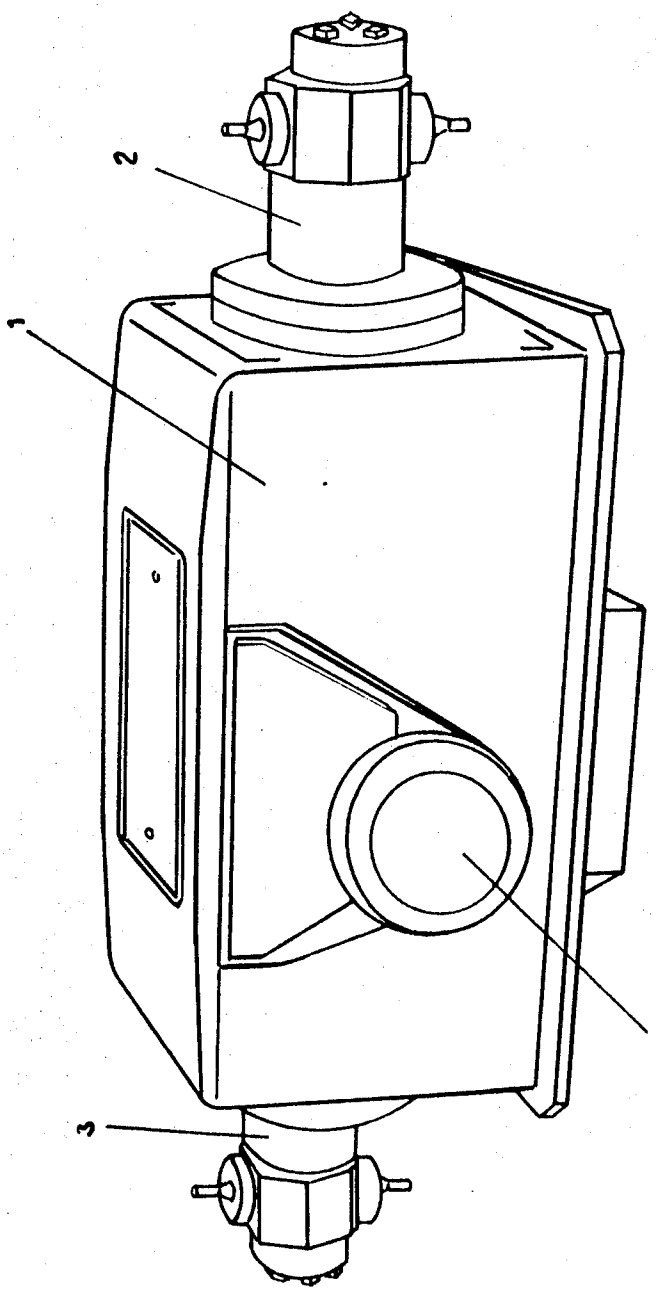


FIG. 1

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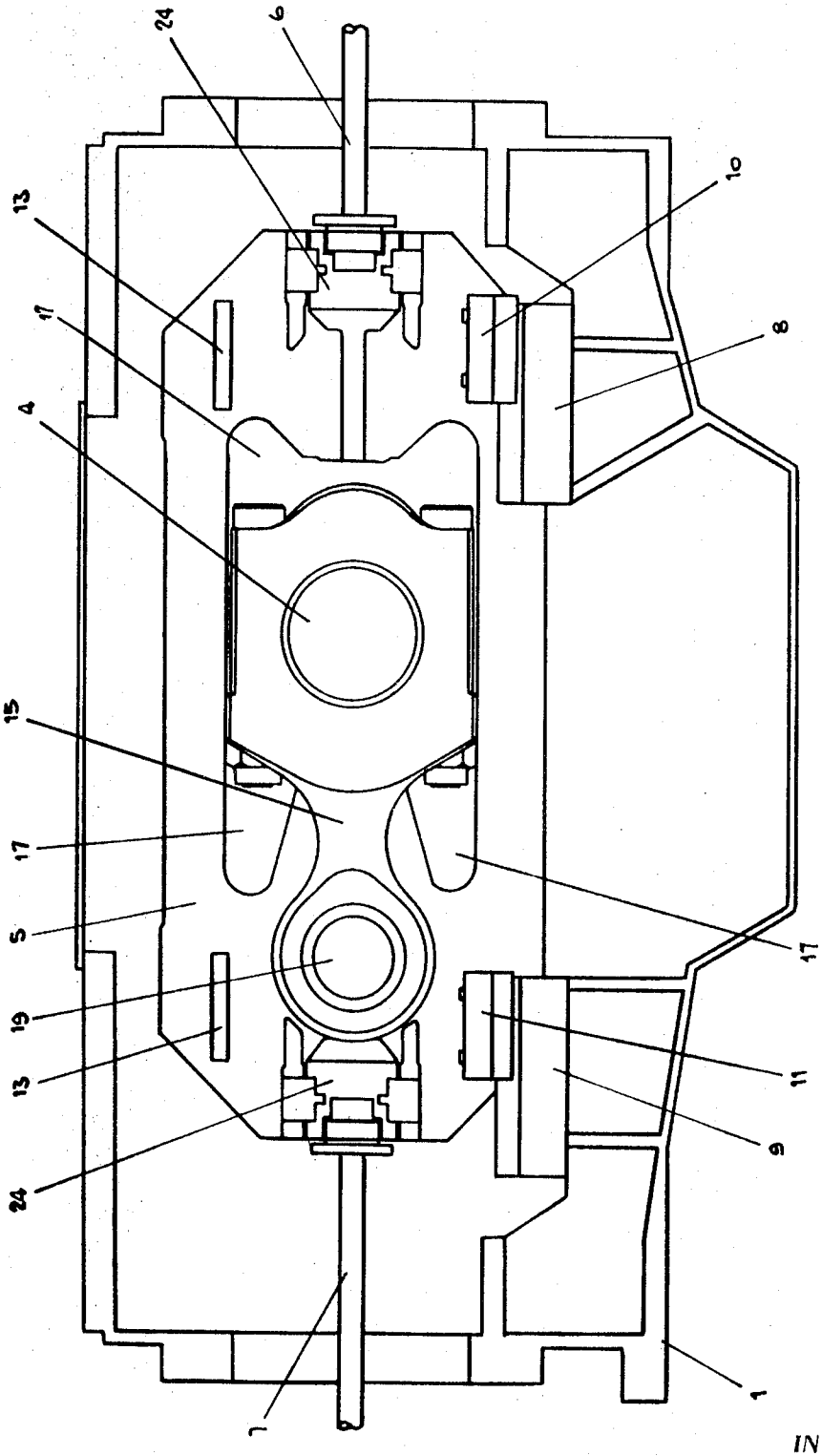


FIG. 2

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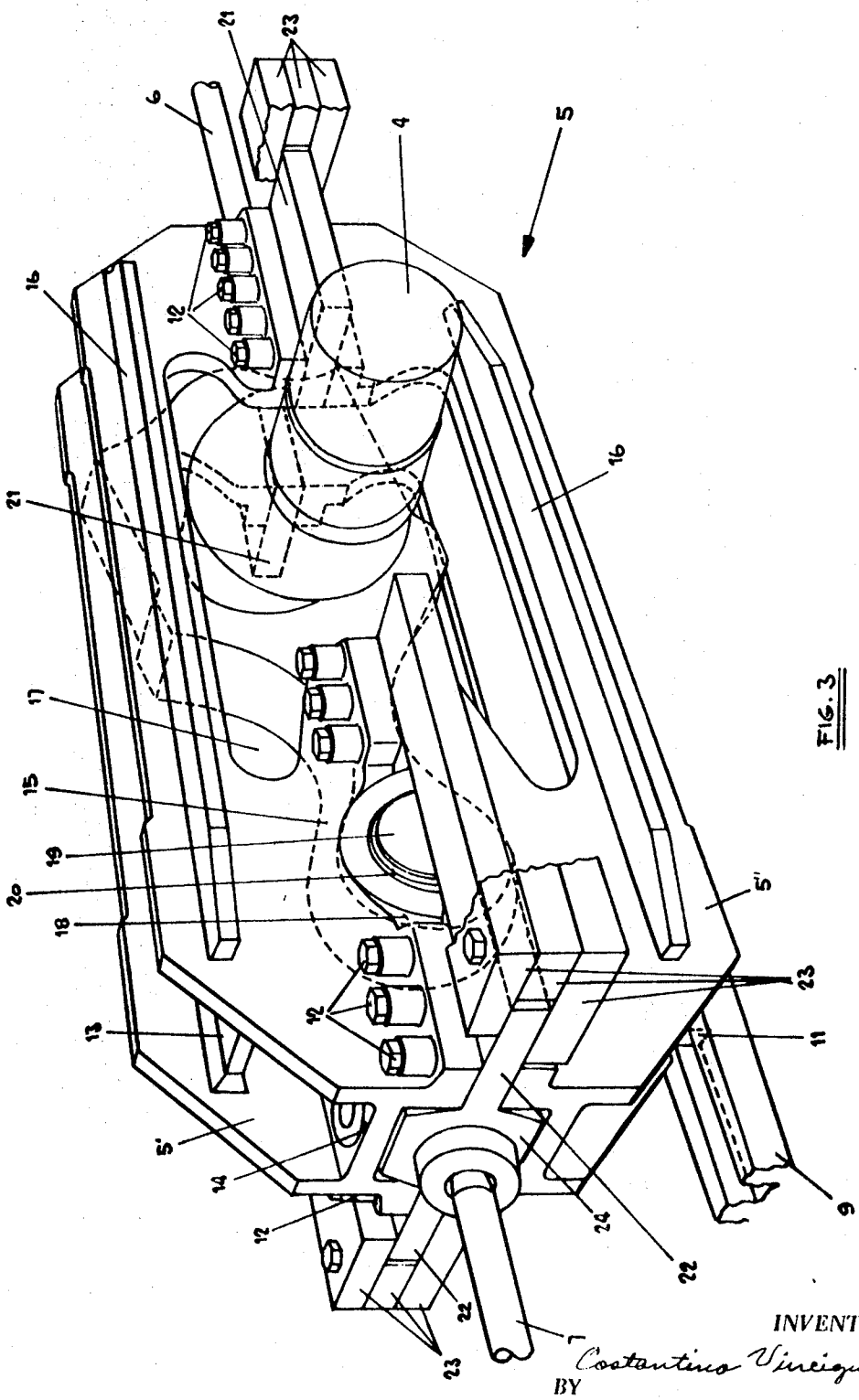


FIG. 3

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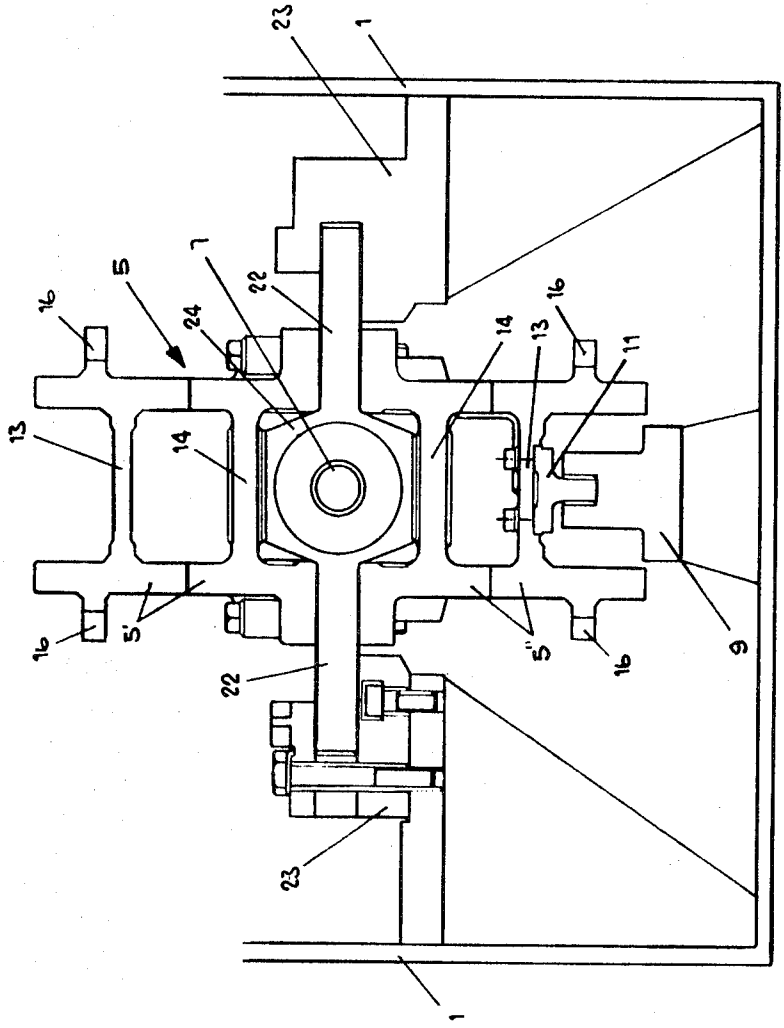


FIG. 4

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CRANK GEARING WITH A SPECIAL CROSSHEAD FOR HIGH PRESSURE RECIPROCATING COMPRESSORS

The present invention relates to a crank gear with a crosshead suitable to operate the pistons of high-pressure reciprocating compressors. The main limiting factor for attaining high pressures--; with a reciprocating compressor, besides the remarkable refinement of the mechanical planning of its different parts, are the mobile seals between piston and cylinder, which undergo a wear proportional to the pressure. In fact an increase of the pressure jump sustained by a sealing element causes an increase of the force pressing the rings against the cylindric wall and accordingly of the wear engendered by the mutual sliding between cylinders and rings during the reciprocating motion of the piston.

On the other hand the piston motion, engendered by the crosshead, is never perfectly coincident with the cylinder axis and this engenders further pressures between rings and piston and continuous bedding motions which contribute, often in a conclusive way, to the failure of a seal.

The work conditions of a seal, both with rings and stuffing box, are more suitable the closer that the piston motion coincides with the cylinder axis and this condition becomes conclusive of whether the compressor will operate at very high pressures.

From what has been said it is clear that in the field of the very high-pressure reciprocating compressors the main problem to be solved, besides the use of particular sealing elements, is the perfect alignment of the piston-cylinder system. Given that the reciprocating motion is engendered by the crosshead, this problem turns into the planning of a crank gear with a crosshead allowing the perfect coincidence of the piston motion with the cylinder axis.

Now, a departure from the conditions of ideal motion, i.e. a cause of misalignment of the piston-cylinder system, is due to the pitching motion of the crosshead which transmits to the piston an oscillatory motion around an axis perpendicular to the one of the cylinder. Said pitching is mainly due to the moment engendered by the friction from the action of the connecting rod around the gudgeon and to the moment arising, in the usual crossheads having a single cylindric guide arranged under the piston axis, in connection with the sliding friction and the inertial forces of the masses dissymmetrically arranged as to the motion axis. Further causes of misalignment derive from initial offsets because of deficiencies of working and assembling and from offsets engendered, mainly in the plane of crank gear, by thermal expansions of the crosshead body.

It is therefore the primary object of the present invention to realize a crank gear with a crosshead for operating the piston of reciprocating compressors which overcomes the foregoing drawbacks, permitting the operation of said compressors in fields of very high pressures.

This is obtained by making use of a crosshead having a particular shape which surrounds the whole connecting rod and, instead of working on normal cylindric surfaces, is guided in its reciprocating motion by two strong wings, arranged on an horizontal plane containing the piston motion axis, extending for the whole length of the crosshead but the central zone let free in order to allow the rotation of the compressor crankshaft. The crosshead is further guided by two other wings arranged in its lower part on a vertical plane containing the motion axis.

It has to be noticed that, given the particular field of application, the crosshead crank gearing is subject to very high pressures and therefore to drawbacks requiring a strict maintenance.

Another object of the present invention is to provide a crosshead crank gearing, which is of a simple structure and a reduced overall size, allowing quick assembly and easy maintenance.

A further object of the present invention is to provide a crosshead crank gearing which simultaneously operates the pistons relating to pairs of opposite cylinders.

The normal use of reciprocating compressors with pairs of opposite cylinders, whose pistons are operated by a single crosshead, is suggested by the great advantages obtained with such a symmetrical arrangement. In fact, when a cylinder sucks, the opposite one compresses and the gudgeon and the crosshead crank gearing have therefore to bear only the difference of the two thrusts, the size of these parts being therefore reduced.

Further, the thrusts acting on the gudgeon of the connecting rod small end, at each turn of the compressor crankshaft, assume equal and opposite values, which, as known, represents the best condition for the running of the crosshead gudgeon.

In fact, the bushing of the connecting rod small end carries out only a small oscillation around the crosshead gudgeon and therefore in the lubrication of such a coupling there is no hydrodynamic effect. If, on the contrary, the thrusts on the gudgeon assume, at each turn of the crankshaft equal and opposite values, there is a satisfactory lubrication due to the alternating introductions and ejections between the working surfaces.

With monodirectional thrusts, like the ones of simple cylinders, there is no such possibility, as the oil is not able to enter between the gudgeon and the bushing, and heavy wear appears quickly.

The invention is illustrated in detail with reference to the enclosed drawings representing a preferred form of realization given only by way of example, as many structural and technical variants may be thought without departing from the range of the present invention.

FIG. 1 shows a perspective view of a reciprocating compressor, with pairs of opposite cylinders, making use of the crosshead crank gearing of the present invention.

FIG. 2 is a vertical section of FIG. 1, illustrating the position of the crosshead inside the box and further illustrating the two rods pertaining to the opposite cylinders secured at the middle point of the front walls of the crosshead, and the flat guides of the two vertical wings of the crosshead.

FIG. 3 is a perspective view of the crank gearing with a crosshead constructed according to the invention.

FIG. 4 shows a front section of the crank gearing with the crosshead 5 of FIG. 3. Referring now more particularly to the accompanying drawings, reference numeral 1 designates a steel box or housing which acts as a support for the two opposed cylinders 2 and 3, and also for the crankshaft 4 of the compressor, wherethrough the crosshead 5 reciprocates. The position of the crosshead 5 inside housing 1, and its remarkable length which is nearly equal to the length of the housing, is best seen in FIG. 2. As also shown in FIG. 2 piston rods 6 and 7, pertaining to the opposite cylinders 2 and 3, respectively, are secured at the middle point of the front walls of the crosshead 5, and flat vertical wing plates 10 and 11 of the crosshead.

In accordance with the invention--; the crosshead 5, comprises an upper rigid steel structure 5' and a similar lower rigid steel structure 5'' symmetrically secured through a series of bolts 12. Each structure comprises two similar sides spaced by means of the blocks 13 and 14 which are integral parts of the sides at their ends. The connecting rod 15 may therefore act in this interspace. As the sides have to bear the stresses exerted by very high pressures, they are reinforced with the ribs 16. Each side further presents an opening 17 wherethrough the crankshaft 4 of the compressor passes. The opening 17 must present a size such as to allow the motion of the crankshaft and therefore the crosshead reciprocation. Each side further presents a semicircular lobe 18 so that the matching of the two structures 5' and 5'' engenders a circular hole wherein the gudgeon 19 of the connecting rod small end passes. Said gudgeon is then secured to the frame formed by said two structures through resilient stop rings 20 having a conical surface fitting on the conical ends of the gudgeon (in FIG. 3 it is possible to see only one stop ring, the other one being arranged on the opposite side, symmetrically as to axis of the rods 6 and 7).

Between the structures 5 and 5'' are introduced two strong steel wing plates 21 and 22 extending on the whole length of the crosshead except for the zone wherein the crankshaft 4 acts. Wing plates 21, 22 protrude from both sides of the frame of the two structures 5' and 5'', forming thereby four sliding blocks entering corresponding flat horizontal guides 23 supported by the box 1. Each of plates 21, 22 present a thickened portion 24 in the middle point of the front thereof, whereto the end of the respective piston rods 6, 7 are secured.

The two wing plates 21 and 22 are secured by means of screws (not shown) to the lower structure 5'' and are further locked between the two structures 5' and 5'' by a series of bolts 12. As clearly seen in FIGS. 3 and 4, wing plates 21, 22 are thus located in a horizontal plane containing the motion axis of the pistons coincident with the axis of the rods 6 and 7. To the spacing blocks 13 of the lower structure 5'' are then bolted two vertical wings 10 and 11 entering suitable vertical flat guides 8 and 9 supported by the box 1 (in FIG. 3 and 4 it is possible to see only the wing 11 and the corresponding guide 9, the wing 10 and the guide 8 being at the other end of the crosshead). The vertical wings 10 and 11 and the corresponding guides 8 and 9, as shown in FIG. 4, are arranged on a vertical plane also containing the motion axis of the pistons, i.e. they are arranged symmetrically as to the front section of the crosshead. Therefore, when because of the rotation of the crankshaft 4 of the compressor the connecting rod 15 transmits a reciprocating motion to the frame formed by the two structures 5' and 5'', said frame, through the wings 21 and 22, is guided, in its reciprocating motion, by horizontal flat guides acting on the plane containing the motion axis of the pistons. In this manner drawbacks resulting from pitching and on the working and assembling imperfections are reduced to negligible limits. The oscillations caused by the pitching become smaller as the gap s between the guides and the sliding blocks of the crosshead becomes narrower and the length l of the sliding of the crosshead becomes larger.

The present crosshead, occupying the most part of the machine width, has a very remarkable sliding length l and the gap s, which in the previous construction of crossheads has to be some tenths mm. for allowing the thermal expansion of the sliding body, as a result thereof may be reduced down to a few hundredths mm., since the distance between the guides is only a few cm.; the resulting oscillations, being proportional to the ratio (s/l), are therefore as small as possible.

On the other hand, by making use of flat guides coincident with the motion axis of the pistons, it is possible to realize a unit wholly symmetrical as to the horizontal plane containing the motion axis: it is possible in this way to remove both the pitching alternating moments due to the frictional forces on the guides and the moments due to the inertial forces of the masses arranged symmetrically as to the motion axis.

The present crosshead, being guided both in a horizontal plane and in a vertical plane containing the motion axis of the pistons through the wings 10 and 11 and the corresponding flat guides 8 and 9, further allows the removal of the offsets due to thermal expansions. These expansions, due to the heating, can not alter the motion axis, as they always occur symmetrically as to said axis.

It is also of out that operating with large sized frames, like the one of the present invention, presents, even making use of high technologies, unavoidable geometrical imperfections. In order to reach the perfection required in aligning the piston-cylinder system, it is generally necessary that a manual adjustment be made. It is clear that such as adjustment is easier in the case of flat guides and surfaces than in the case of the usual cylindrical guides and surfaces: this is a further advantage of the invention.

Finally the crosshead of the invention allows a quick and easier maintenance in case of damages. The usual crossheads are shaped in such a way that the removal of one of their parts causes the remaining part to the unstable or unsupported, this requiring, in case of maintenance, the disassembling of the whole crosshead element by element and of course loss of time. In our case, on the contrary, it is enough to unscrew the series of bolts 12 and remove only the upper structure 5' for making easily accessible any part of the crosshead.

The unit, in fact, once the structure 5' is removed, does not become unstable but remains stabile and rigid, as the wing plates 21 and 22, resting on the corresponding guides 23, support the whole frame as they are rigidly screwed to the lower structure 5''. The alignment of the rods and guides is not altered as these remain secured to the lower structure 5''.

I claim:

1. In crank gearing mechanism for operating a pair of opposed pistons adapted to reciprocate in a corresponding pair of opposed cylinders of a high-pressure reciprocating compressor or the like, including a housing structure supporting each of said opposed cylinders, the compressor crankshaft, a reciprocating crosshead actuating said opposed pistons, and a connecting rod connecting said crankshaft with said crosshead, the improvement therein which comprises:

said crosshead comprising

a pair of identical upper and lower frame sections fixedly removably secured together in opposed relationship to form a rigid crosshead frame structure extending longitudinally over a major portion of the length of said housing structure, each of said upper and lower frame sections including a pair of spaced, vertically extending sidewalls,

said sidewalls of said frame sections having identical, opposed first and second openings therein, whereby when said upper and lower frame sections are secured together in opposed relationship the spaced sidewalls of said frame structure are adapted to receive said connecting rod therebetween, the opening formed by said first openings is adapted to rotatably receive the connecting rod gudgeon therein, and the opening formed by said second openings is adapted to receive said compressor crankshaft therein and to accommodate the movement thereof,

each of said upper and lower frame sections further including reinforcing spacing block means secured between said sidewalls at the opposite ends thereof; and

a pair of plate members secured between said upper and lower frame sections,

each of said plate members having an enlarged central portion enclosed by said frame sidewalls and flat wing portions extending horizontally outwardly from each of said frame sidewalls,

said central portions of said plate members adapted to fixedly house the respective piston rods of said opposed pistons in the horizontal plane defined by said wing portions of said plate members, and

said plate wing portions extend along the length of said crosshead frame structure from the ends thereof to said opening receiving said compressor crankshaft.

2. Crank gearing mechanism as defined in claim 1 wherein said crosshead further includes a pair of vertical flat wing plate portions secured to said lower frame section in a vertical plane containing the motion axis of said piston rods.

3. Crank gearing mechanism as defined in claim 1, wherein said sidewalls of said upper and lower frame sections of said crosshead frame structure include reinforcing rib means.

4. Crank gearing mechanism as defined in claim 1, wherein said housing structure includes horizontal guide means slidable receiving said horizontal plate wing portions therebetween, to thereby guide said crosshead frame structure in a horizontal plane which includes the motion axis of said piston rods. 14

5. Crank gearing mechanism as defined in claim 2, wherein said housing structure includes vertical guide means slidably receiving said vertical wing plate portions therebetween, to thereby guide said frame structure in a vertical plane which includes the motion axis of said piston rods.