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[54] **HIGH-PRESSURE COMPRESSORS AND PUMPS**

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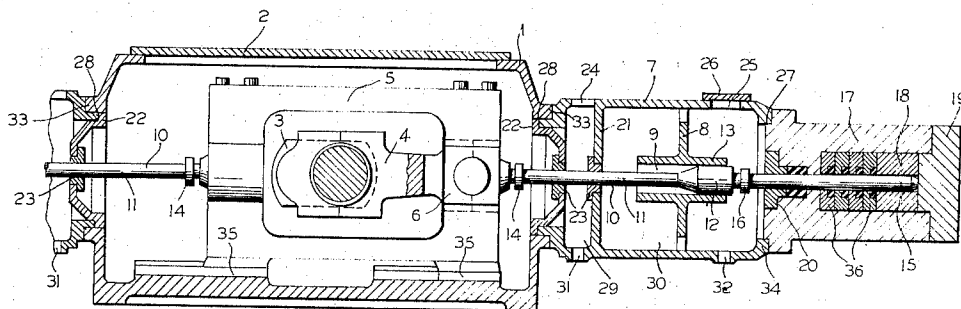
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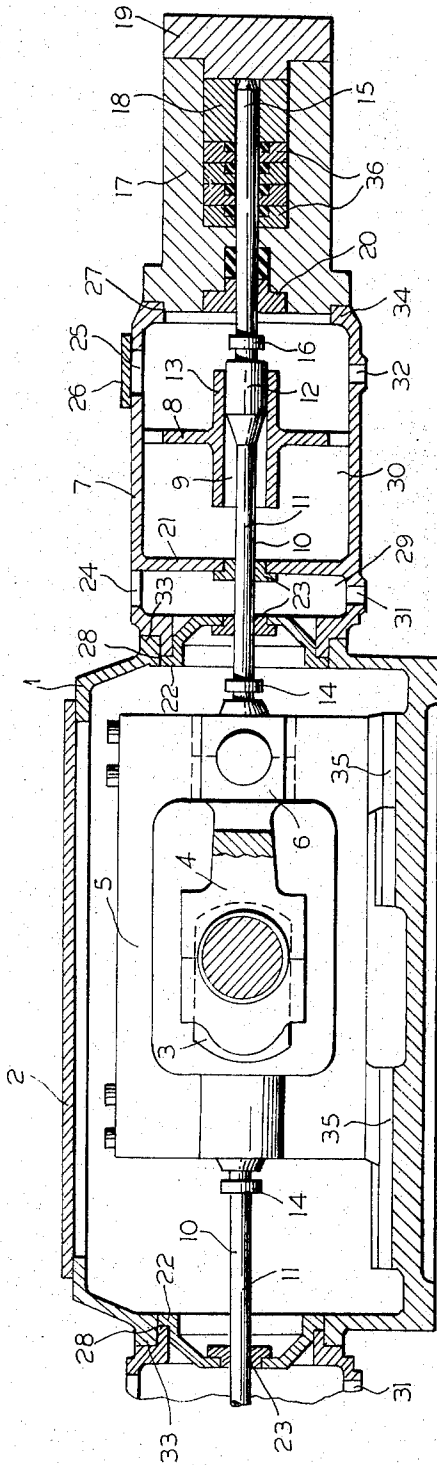
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[57] **ABSTRACT**

The invention has as its subject an arrangement for the axial longitudinal guiding of the piston of a high-pressure compressor machine within its working cylinder which allows the piston to be guided independently of the usual cross-head guide, and this is achieved by means of a lantern member connected to the frame of the crank drive and having a guide bore, coaxial with the bore of the working cylinder. The outer end of the piston is received in the lantern member and is connected to a cross-head within the crank-drive frame by a resilient connecting rod which is guided in the guide bore of the lantern member.

10 Claims, 1 Drawing Figure





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HIGH-PRESSURE COMPRESSORS AND PUMPS

This invention relates to piston-compressors and pumps and especially is concerned with the axial longitudinal guiding of the piston within the working cylinders of a high-pressure compressor or pumps, that is to say one which delivers the medium at a pressure of some thousands of atmospheres.

A principal object of the invention is an arrangement which permits the axial longitudinal guiding of the piston of such a machine independently of any cross-head guide.

The length of the piston subjected to pressure action at the end face is determined by the necessary space required for coupling to the cross-head, the overall length of the cylinder packing elements, and the travel distance.

Since in the case of pumps or piston compressors operating with very high pressures the pressure on the suction side may be extremely high, e.g., more than 1,000 atmospheres, even with a considerable delivery there are relatively small swept volumes and thus, with a given piston travel, slender pistons of relatively small diameter which are subjected to buckling stress, and this, taking into account the piston force resulting from the effective diameter and taking into account the permissible values for the buckling stress, limits the overall length of the piston which is axially mobile longitudinally in the cylinder bore.

This length limitation makes it necessary for the piston coupling for transmission of force to the cross-head to come to be situated in the end position of the piston within the cylinder as near as possible to the piston entry point of the working cylinder nearest the cross-head. This is achieved in the usual compressors operating with very high pressures by flange-connecting the working cylinder directly to the end face of the crank-drive frame. The spacing of the cylinder connecting flange from the cross-head in this dead centre position in the direction of the cylinder is determined by the necessary space required for the piston coupling elements between the preliminary stuffing-box inserted at the cylinder end and the cross-head end face.

By the arrangement of the piston coupling at the cross-head and the preliminary stuffing-box within the crank-drive frame, access for dismantling these parts is made very difficult, more particularly in the case of large machine units. Precise aligning and centering of the piston guide relatively to the cylinder axis is very difficult and time-consuming. The slightest deviation of the piston axis fixed by the cross-head guide from the axis of the cylinder fixedly arranged on the drive frame can, more particularly when the occurrence of tilting movements of the cross-head in the cross-head guideway and as a result of transverse movements of the cross-head within the cross-head shoe clearance and as a result of the influence of uncontrollable thermal expansion, result in longitudinal movements of the piston within the cylinder bore which deviate from the cylinder axis, and thus cause a rapid wear on the piston sealing elements.

With this arrangement, there is also the disadvantage that when leakages occur in the sealing elements for the piston and the preliminary stuffing-box, more particularly if the discharge gas conduits in the preliminary stuffing-box are blocked by deposits from the medium being sealed or if relatively considerable leakages cause an increased pressure loss in the discharge gas conduit, the medium to be delivered by the compressor may flow into the interior of the drive frame.

If the compressed medium is a combustible gas, this inflow may give rise to serious explosions owing to the formation of a detonating gas mixture in the crank-drive housing.

If in order to avoid the risk of explosions or for some other reason the drive housing is kept open, the leakage gas may flow directly out into the compressor room, in which case the entire room is subjected to the risk of an explosion.

With the conventional constructional arrangement it is also possible, besides the medium, for cylinder-lubricating oil to get into the interior of the drive frame, so that mixing with the drive-lubricating oil takes place. With considerable differences in the quality, the chemical composition and the

viscosity of the lubricants used for lubricating the cylinder and the drive, this mixing may have a detrimental influence on the lubricating ability of the drive oil which generally flows through a circuit.

Compressors are also known which have flanged working cylinders directly connected to the crank-drive frame and which have an axially longitudinally movable, hollow drilled guide piston inserted in the cross-head side end of the working cylinder. In such machines the guide piston has a fixed abutment collar and is connected with the coupling at the cross-head by means of a union nut and a relatively short and of itself rigid joining element inserted into the bore of the guide piston and having cup shaped end faces on both sides.

In the event of axis displacements between cylinder guide and cross-head guide it is intended that with the joint element, owing to its mobility in the bearing contact elements provided at both sides with cup-shaped recesses, the appropriate compensation in the piston guide should be achieved in such a manner that the axial longitudinal movement of the piston in the cylinder bore is guaranteed without deviation.

With very considerable piston forces and the high pressures per unit of surface area necessarily resulting therefrom in the bearing contact surfaces, when tilting movements of the cross-head occur the intended mobility of the joint element may become very problematical, and, if a swinging movement is obtainable at all, wear may quite well occur in the bearing contact surfaces with the relatively small rolling movements which result.

A particular disadvantage in this arrangement is that in order to demount the piston, which at its rear end, for pressure against the joint element, comprises a securely arranged collar with a larger diameter than that of the piston, all the cylinder inner parts have to be taken out, and this requires a considerable amount of time. With this arrangement there is also the same disadvantages already mentioned hereinbefore as regards the possibility of entry of conveyed medium and cylinder lubricant into the interior of the drive frame if leakages occur in the sealing elements of the working cylinders.

A high-pressure compressor or pump (compressor machine) in accordance with the invention is characterised by an arrangement for the central guiding of the piston in a working cylinder according to which the working piston is received at its end face in a lantern member connected to a crank-drive frame, and the piston is connected releasably to a cross-head within the said frame by means of a resilient connecting rod guided in a guide bore within the lantern member which is coaxial with the piston bore of the working cylinder in the direction determined by the travel of a cross-head pivot pin member, and the construction of the lantern member is such as to obviate entry of the pumped medium into the interior of the crank-drive frame and also mixing of cylinder lubricant with drive lubricant in the event of leakage.

The underlying idea of the invention is illustrated with reference to an example of a specific embodiment shown in the accompanying drawing. The embodiment used for the description of the subject of the invention and to illustrate same is an arrangement such as is conventionally used for very high pressure compressors or pumps with working cylinders arranged opposite one another on the drive.

Within a drive frame 1 which is adapted to be closed by a cover 2 a frame-form cross-head 5 is given a reciprocating longitudinal movement on rotation of a crankshaft 3 through the agency of a connecting rod 4.

The lantern members 7, which are each provided with a guide cylinder 13, are securely connected to the drive frame 1 together with the working cylinders 17 which are arranged on the end connecting flanges 34 of the said lantern members, at two opposite end connecting flanges 33 of the said frame.

The direction-determining precise central position of the axis of the cylinder 17 and thus of the bores of cylinder liner 18 and the piston sealing elements 36 relatively to the guide axis of the cross-head pivot pin member 6 is precisely deter-

mined on the one hand by the centering in the housing bore 28 of the frame flange 33 and on the other hand by the centering of the cylinder 17 in the housing bore 27 on the end connecting flange 34 of the lantern member 7.

The interior of the lantern member 7 is sub-divided by a partition wall 21 into two chambers 29 and 30. The chamber 29 at the side of the frame connecting flange 33 is at one side bounded by a cover 22 inserted centrally in the left-hand housing bore of the lantern and at the other side by the partition wall 21.

The partition wall 21 and the cover 22 are each provided, for the through passage of the connecting rod 10, with an axial bore for receiving rod sealing elements 23, of known type. The chamber 29 communicates with the outside air by way of one or more apertures 24.

A connecting aperture 31 for discharging any lubricating oil which may collect is situated at the lowest point.

The chamber 30 is bounded at one side by the partition wall 21 and at the other side by the inner end face of the working cylinder 17 arranged centrally on the connecting flange 34.

The chamber 30 is provided above or laterally with one or more assembly apertures 25 which are adapted to be closed with covers 26 and which may be left open in the case of subjecting a non-volatile liquid to compression (construction in the form of a high-pressure pump). At the lowest point of the chamber 30 there is situated a connecting aperture 32 for discharging collecting lubricating oil from the cylinder 17.

Also arranged in the chamber 30, connected fast by means of the webs 8, is a guide cylinder 13 whose bore 9 for guiding purposes extends coaxially relatively to the housing bores of the sealing elements 23 inserted in the partition wall 21 and cover 22.

The cylinder 17 being concentric within the housing bore 27 at the connecting flange 34, the bore 9 is coaxial with the bores of the cylinder liner 18 and the piston sealing elements 36. The guide piston 12 of the connecting rod 10 which serves as a connection between piston 15 and cross-head 5, which guide piston is adapted to move longitudinally in the axial direction and is connected fast to the shank portion 11, is inserted in the guide bore 9.

The dimension of the solid or hollow-drilled shank portion 11, which is preferably made with a round cross-section, are such that under the full action of the pressure acting on the end face of the piston 15 it has sufficient resistance to lateral buckling and such elasticity that the lateral deviations of the shank part 11 occurring at the rod coupling 14 on longitudinal movement at the cross-head 5 can be accepted, while allowing axial longitudinal movement of the guide piston 12 in the bore 9.

With the sealing elements 23 of known construction surrounding the shank portion 11, on the one hand the chamber 30 and on the other hand the interior of the drive frame 1 are effectively sealed relatively to the chamber 29 which is in direct communication with the outside air. The sealing elements are so inserted that they can follow the lateral movements of the shank 11 when the latter moves longitudinally, while maintaining their sealing ability.

The chamber 30 is brought into communication (by means not shown) either with a low-pressure gas holder or, through a large gas discharge conduit, with the outside air. In the latter case the covers 26 can be provided, as an additional safety measure, with explosion valves in the constructional form known in large diesel engine construction (not shown). In this way the gas pressure in the chamber 30 can be kept very low, so that only extremely small gas traces can pass through the seal 23 into the machine room from the cylinders 17 even in the event of relatively large leakage losses.

The releasable connection of the piston 15 to the connecting rod 10 is effected with the coupling element 16 arranged centrally at the end of the guide piston 12. The assembly apertures 25 arranged at the lantern member 7 above the chamber 30 are so dimensioned as to permit the coupling and uncoupling of the piston 15 and also the fitting and dismantling

of the cylinder preliminary stuffing-box 20 inserted at the inner end of the cylinder 17.

Owing to the arrangement of the connecting rod 10 with axial longitudinal mobility of the guide piston 12 arranged securely on the resilient shank 11, and of the smallest possible diameter and great length, in the lantern member 7 the following advantages are obtained relatively to the known machine arrangements:

1. Owing to the elasticity of the shank 11 even when displacements occur of the guide axis associated with the cross-head pivot pin member 6 relatively to the axis of the cylinder bore formed of the cylinder liner 18 and piston sealing elements 36, during longitudinal movement within the cylinder 17, no considerable deviation of the piston 15 from its axial direction of movement occurs, nor any unacceptable bending stress on the piston 15. Thus it is possible to obtain optimum precision in the axial guiding of the piston 15 within the cylinder 17. Since there is no reaction of any kind due to the heavy drive parts when movements occur in the guideway 35 of the cross-head 5, in this way wear which occurs in the case of movements of the piston 15 away from the axis is eliminated to a very considerable extent in the sensitive sealing elements 36 of the inner parts of the cylinder.

2. With the illustrated arrangement, at the time of assembly exact centering of the cylinder 17 with the cylinder liner 18, the sealing elements 36 and the inserted piston 15 is obtained automatically, without requiring special checking for the purpose as regards the precise alignment relatively to the guide axis of the cross-head guideway 35. By omitting the involved work required for alignment, a not inconsiderable saving in time is obtained when replacing the sealing elements or the complete cylinder 17.

3. For fitting and demounting the piston 15, there is easy access to the piston coupling 16 owing to the assembly aperture 25 within the chamber 30, which aperture is adapted to be closed with the cover 26. The end of the piston 15 at the coupling side can be so constructed, with the use of known multi-part clamping elements engaging in a piston groove, that for removal of the piston after the removal of the cylinder head 19 or a closure member (not shown) inserted axially therein, the piston 15 can be readily pushed through the bores of the sealing elements 20 and 36 and the cylinder liner 18, without the inner parts of the cylinder having to be removed from the cylinder 17 for this purpose.

4. When leakage of the medium concerned takes place, the complete separation of the working cylinder 17 from the drive frame 1 means that no penetration of the medium into the interior of the drive frame 1 is possible, since an intermediate chamber 29 communicating with the outside air is arranged in the lantern member 7 before the connection to the drive frame 1.

5. Owing to the subdivision of the lantern member 7 into two chambers 29 and 30 through which the connecting rod 10 extends, it is possible to separate the lubrication of the cylinder completely from the lubrication of the drive. If a leak occurs in the preliminary stuffing-box 20 fitted in the cylinder 17, the cylinder-lubricating oil which issues passes into the chamber 30 where it flows out together with the lubricating oil from the lubrication of the guide piston 12, which is attended to by the cylinder-lubricating system, through the outlet aperture 32 arranged below.

When a leak occurs in the sealing element 23 fitted in the cover 22, the drive-lubricating oil flows into the chamber 29 from which it can flow out through the outlet aperture 31 which is arranged below.

Thus the possibility of the cylinder-lubricating oil penetrating into the drive frame, or the drive-lubricating oil into the cylinder-lubricating system, is substantially obviated.

I claim:

1. A high-pressure piston compressor machine comprising a working cylinder, a working piston in said cylinder, means for centrally guiding said piston in said cylinder comprising a crank-drive frame, a lantern member connected to said frame

receiving the end face of said piston, a cross-head having a cross-head pivot pin member within said frame, a resilient connecting rod releasably connecting said piston to said cross-head, said lantern member having a guide bore coaxial with the piston bore of said working cylinder for guiding said connecting rod in the direction determined by the travel of said cross-head pivot pin member, said lantern member comprising means to prevent entry of the pumped medium into the interior of said crank-drive frame and means to prevent mixing of cylinder lubricant with drive lubricant in the event of leakage.

2. A high-pressure piston compressor machine according to claim 1 wherein said frame has a guideway for said cross-head and said connecting rod has an elastic shank portion to follow the axis deviations of said cross-head without prejudicing the axial position of said piston as determined by said guide bore.

3. A high-pressure piston compressor machine according to claim 1 wherein the cylinder-side end of said connecting rod comprises a guide piston longitudinally movable axially in said guide bore and a coupling connecting said guide piston and said connecting rod for the releasable connection of said piston.

4. A high-pressure piston compressor machine according to claim 1 wherein a partition wall sub-divides the interior of said lantern member into two chambers, a closure cover on one of said chambers at the side of said drive frame and the other of

said chambers being closed by the rear end of said working cylinder.

5. A high-pressure piston compressor machine according to claim 4, wherein one of said chambers has communication with the exterior.

6. A high-pressure piston compressor machine according to claim 5 wherein said chamber communicating with the exterior communicates through a venting device.

7. A high-pressure piston compressor machine according to claim 4, wherein said other chamber has at least one assembly aperture whose size is determined by the space required for operating said coupling.

8. A high-pressure piston compressor machine according to claim 4, wherein said one chamber communicates with a low-pressure gas holder.

9. A high-pressure piston compressor machine according to claim 4 wherein said two chambers each have at the lowest point an aperture for the outflow of lubricant flowing into the respective chambers.

10. A high-pressure piston compressor machine according to claim 4 wherein said partition wall and said closure cover have coaxially arranged housing bores and sealing elements are arranged with lateral mobility in said bores for sealing said connecting rod passing therethrough.

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