United States Patent

Zurcher

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[54] GUIDE MEANS FOR A PISTON IN A CYLINDER

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[51] **Int. Cl.**.....**F01b 31/00**

[58] **Field of Search** .....92/162, 248, 249, 253; 308/5, 308/DIG. 7; 188/316; 277/53, 75, DIG. 6

[56] **References Cited**

UNITED STATES PATENTS

3,447,427	6/1969	Mickle	92/253
3,155,015	11/1964	Genz	92/249
3,035,879	5/1962	Hanny et al	92/162

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[57] **ABSTRACT**

The piston is provided with a thin-walled split ring which has grooves in the outer periphery communicating the end faces of the ring with each other. The ring serves to guide the piston in the cylinder during abnormal operating conditions and is made of an antifriction material so that wear between the piston and cylinder is reduced to a minimum.

10 Claims, 5 Drawing Figures

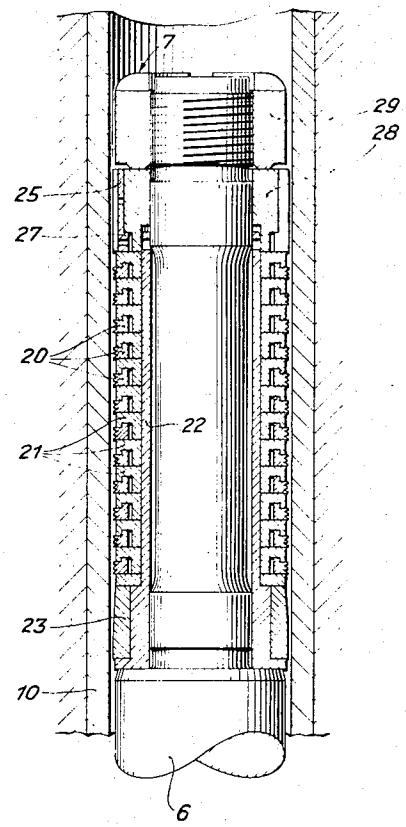

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Fig. 1

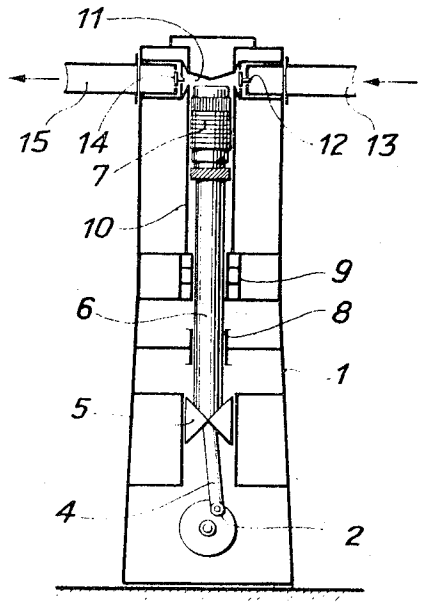

Fig. 5

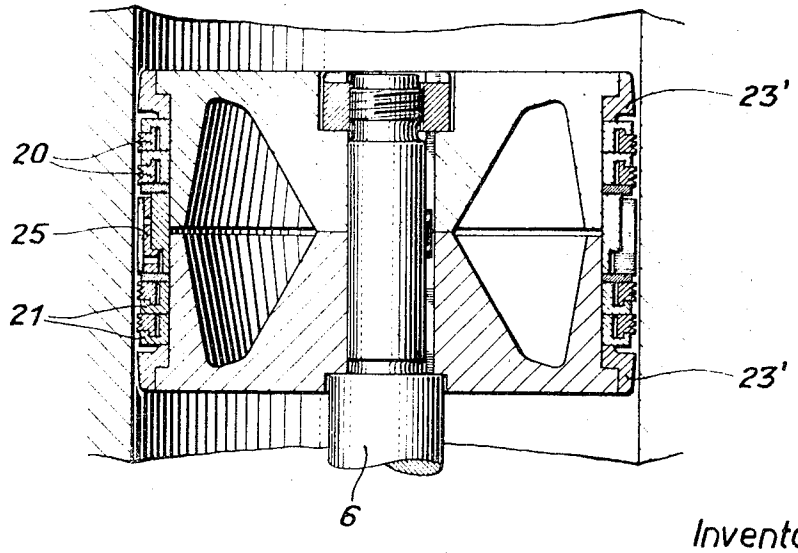

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Fig. 2

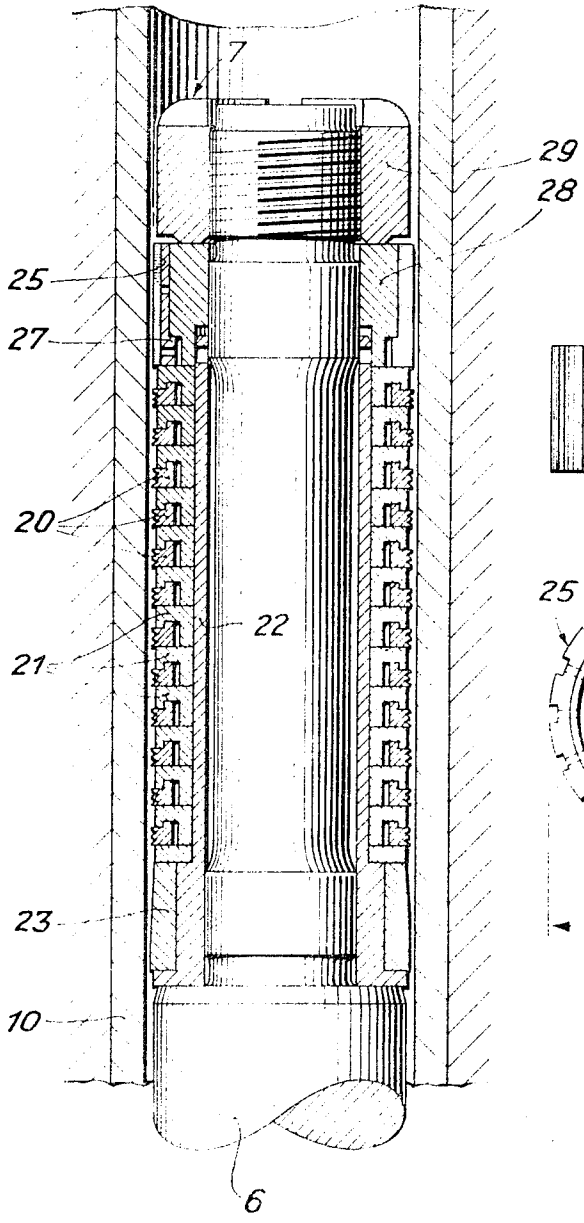


Fig. 3

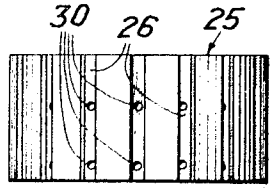
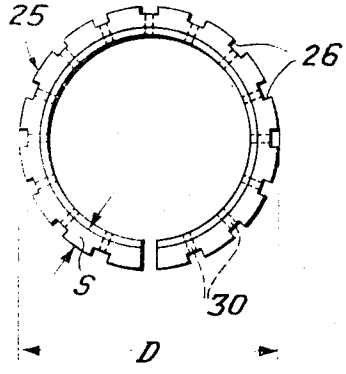


Fig. 4



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GUIDE MEANS FOR A PISTON IN A CYLINDER

This invention relates to piston compressors. More particularly, this invention relates to piston compressors having a piston mounted in spaced relation to a cylinder. Still more particularly, this invention relates to a means for guiding a piston in a cylinder during abnormal operating conditions.

Compressors have been known in which pistons have been spaced from a surrounding cylinder with substantially no physical contact between the piston and cylinder. This spacing apart of the piston from the cylinder has usually been achieved by means of a gas bearing which operates so that in the event the piston assumes an off-center position, the different gas pressures operative in the gaps of different widths between the piston and the cylinder automatically return the piston to a central position. However, in such compressors abnormal operating conditions may occur in which the gas bearing is inoperative, e.g., on starting, due to the absence of gas pressure, or, in the case of normal operation, due to unilateral heating of the piston rod. When these conditions occur, the piston can become deflected or skewed into contact with the cylinder. Upon subsequent reciprocation of the piston, wear will occur on the piston and/or cylinder. This leads to a shorter piston life, greater maintenance care and cost and further damage to the piston seals and other components of the compressor.

Accordingly, it is an object of the invention to reduce wear between a piston and cylinder of a compressor.

It is another object of the invention to prevent contact during abnormal operating conditions between a piston and cylinder which are normally spaced apart circumferentially.

Briefly, the invention provides the piston of a piston compressor in which the piston is in reciprocal and spaced relation to a cylinder with a guide means which is positioned on the piston so that during abnormal operating conditions, should the piston skew, the guide means comes into sliding contact with the cylinder while maintaining the piston out of contact with the cylinder. The guide means can be in the form of a split ring which has grooves in the outer periphery to connect the end faces of the ring to equalize the pressures on those faces as well as radial holes to equalize the pressures between the inside and outside of the ring.

Since the guide ring is to contact the cylinder, the guide ring is made of a suitable antifriction material such as a self-lubricating plastic. To this end, the ring can be made of Teflon.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates a vertical section through a single stage compressor having a single acting piston with a guide means according to the invention;

FIG. 2 illustrates a sectional view of the piston of FIG. 1 on an enlarged scale;

FIG. 3 illustrates a view of a guide ring according to the invention;

FIG. 4 illustrates a plan view of the ring of FIG. 3; and

FIG. 5 illustrates a view of a double acting piston with a guide ring according to the invention.

Referring to FIG. 1, the single stage compressor has a casing 1 which houses a crank shaft 2 which drives a piston 7 via a connecting rod 4, a crosshead 5 and piston rod 6. The piston rod 6 is guided in a guide for the crosshead 5 as well as in a straight guide 8. In addition, the piston rod 6 is sealingly mounted in a piston rod seal or bush 9, as is known, for example, in a plurality of labyrinth graphite rings.

The piston 7 is further disposed concentrically within a cylinder 10 in spaced circumferential relation so as to avoid physical contact therewith. The cylinder 10 communicates with a compression chamber 11 above the piston 7 to which an inlet duct 13 and a delivery duct 15 are connected by suitable inlet and outlet valves 12, 14 respectively.

Referring to FIG. 2, the piston 7 has a number of sealing rings 20, the outer peripheries of which are provided with labyrinths. These sealing rings 20 alternate with rings 21 which are situated on a bush 22 surrounding the piston 7 and which engage over the labyrinth sealing rings 20 by means of shoulders and thus define the outside diameter of the sealing rings 20. The bush 22 also carries a conical ring 23 on the bottom end which serves to center the piston 7 aerodynamically when the compressor is in operation.

The piston 7 also carries a guide means at the top in the form of a split ring 25. As shown in FIGS. 2, 3 and 4, the split ring 25 has a plurality of axial grooves 26 on the outer periphery which interconnect the two end faces of the ring 25 so as to equalize the pressures above and below the ring 25. As shown in FIG. 2, the ring 25 has a thicker portion 27 at the bottom end than the remainder of the ring 25 which is thin-walled. This thicker portion 27 forms a shoulder which, for reasons associated with thermal expansion, is as short as possible in an axial direction and is retained axially by means of a bush 28 and a nut 29 threaded on the piston 7. Apart from the grooves 26, the ring 25 also has holes 30 which extend radially from the base of the grooves 26 and provide for pressure equalization between the inside and outside of the ring 25. The ring 25 is made of a material which has good dry running properties, e.g., polytetrafluorosthylene (Teflon), and may have inclusions of graphite or other substances. For reasons associated with thermal expansion, the wall thickness S of the ring 25 is made as thin as possible in relation to the diameter D of the ring 25.

In operation, when the compressor is started, there is the possibility that the piston 7 will not operate in the cylinder 10 without physical contact, because the gas pressure from the compression chamber 11 may be inadequate for automatic centering of the piston by means of the conical ring 23. In this case, the ring 24 guides the piston 7 without performing any sealing function. Since there is always an equalization of the pressures above and below the ring 25 by way of the axial grooves 26, the sealing function is carried out by the sealing rings 20. Further, since the ring 25 is slotted, there is practically no radial expansion of the ring 25 due to heating.

Should the piston 7 deflect towards the cylinder 10 during start up, the guide ring 25 slidingly contacts the cylinder 10 while maintaining the piston 7 out of contact. After the pressure has been built up, the gas flow can be relied on to center the piston 7 in the cylinder 10. At this time, the ring 25 moves out of contact with the cylinder 10.

During normal operation of the compressor, there is generally no contact between the cylinder 10 and the ring 25. However, should an abnormal state of operation occur, for example, if the piston rod 6 is heated on one side only to cause a deflection of the piston 7, unless the deflection is compensated by an automatic centering the ring 25 will again bear against the cylinder wall to prevent any damage to the piston 7.

Referring to FIG. 5, in the case of a double acting piston on a piston rod 6, a guide ring 25, as above, is mounted in the middle of the piston between a pair of labyrinth sealing rings 20. In addition, a conical centering ring 23' is mounted on each end of the piston in order to aerodynamically center the piston during operation. Alternatively, other means can be used to center the piston by means of the compressed gas.

It is noted that the use of the guide ring 25 is not restricted to those pistons having labyrinth sealing rings but can also be applied to piston compressors whose pistons are themselves constructed as labyrinth pistons, i.e., in which the labyrinths are formed in the piston wall.

The invention thus provides a guide means which prevents a piston from contacting and sliding against a cylinder. The guide means in the form of a split ring can be easily manufactured and installed in place with a minimum of effort. Further, the invention provides a guide means which serves to protect the sealing rings of a piston against wear and damage should the piston skew out of alignment within the cylinder in which the piston is mounted in spaced relation.

What is claimed is:

1. In combination,

a compressor,

a cylinder within said compressor,

a reciprocal piston disposed within said cylinder is spaced concentric relation,

labyrinth seal means on said piston in spaced annular relation to said cylinder, and

a thin-walled split guide ring mounted on said piston and being of an outer diameter less than the inner diameter of said cylinder to guide said piston in said cylinder while maintaining said piston and labyrinth seal means out of contact with said cylinder in response to skewing of said piston in said cylinder,said guide ring having grooves in the outer periphery thereof communicating the end faces of said ring with each other.

2. The combination as set forth in claim 1 wherein said ring further has a plurality of radial holes in the plane of said grooves passing therethrough to communicate the inside with the outside of said ring to equalize pressure between said inside and said outside of said guide ring.

3. The combination as set forth in claim 1 wherein said ring is made of antifriction material.

4. The combination as set forth in claim 3 wherein said ring is made of polytetrafluoroethylene.

5. In a piston compressor having a cylinder, a piston reciprocally mounted in spaced concentric relation to said cylinder, and labyrinth sealing means on said piston in spaced concentric relation to said cylinder; a guide ring on said piston for guding said piston in said cylinder while preventing contact of said piston and said sealing means with said cylinder, said ring being of an outer diameter less than the inner diameter of said cylinder thereat and having grooves therein communicating the end faces of said ring with each other.

6. In a piston compressor as set forth in claim 5 wherein said piston has a centering means mounted on one end thereof and said guide ring is mounted at the opposite end.

7. In a piston compressor as set forth in claim 5 wherein said piston is a double acting piston having a centering means mounted at the opposite ends thereof and said guide ring is mounted intermediately of said ends.

8. A piston-type compressor having a cylinder defining a bore, a gas supported piston within said bore and labyrinth seal means on said piston; a split thin walled guide ring mounted on said piston in fixed axial relation and in radially movable relation, a plurality of axial passages extending along said guide ring and a plurality of radial passages extending through said guide rings for pressure equalization, said guide ring having a minimum clearance with respect to said cylinder bore whereby in normal operation of the compressor said guide ring is spaced from said cylinder bore and upon skewing of said piston said guide ring contacts said cylinder bore to guide said piston in said cylinder bore with said seal means spaced from said cylinder bore.

9. A piston-type compressor as set forth in claim 8 wherein said seal means includes a plurality of sealing rings, each ring having a shoulder thereon, and a plurality of rings each secured to said piston and having a shoulder thereon overlapping a shoulder of a sealing ring and being of a diameter at least equal to the outside diameter of said shoulder of said sealing ring.

10. A piston-type compressor as set forth in claim 9 wherein said rings on said piston are closed.

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