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COMPRESSOR PISTON

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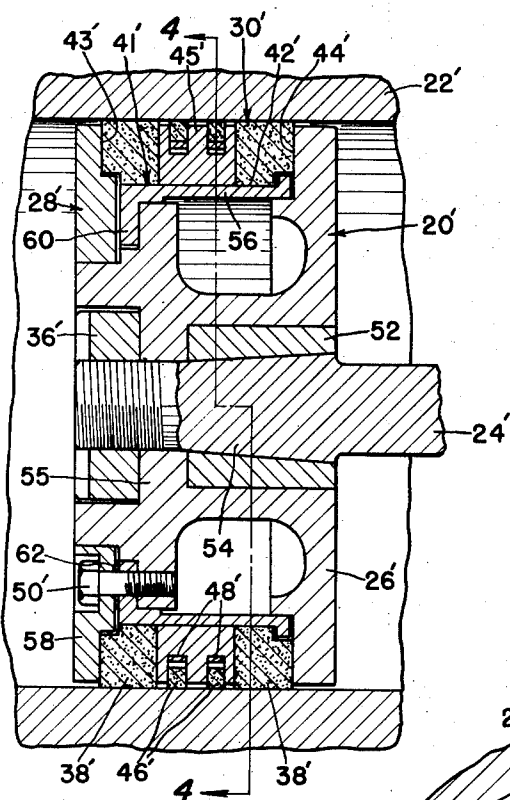


FIG. 3

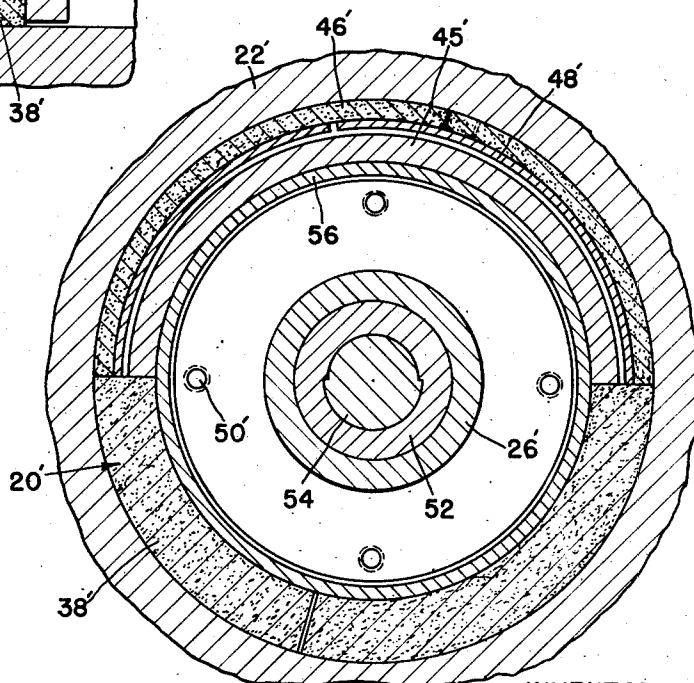


FIG. 4

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COMPRESSOR PISTON

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3 Claims. (Cl. 309—4)

This invention relates to pistons, and more particularly to pistons used in pumps for pumping oil-free gases or liquids where no contamination from lubricating oil can be tolerated.

One object of the invention is to effect adequate lubrication between a piston and a cylinder without employing an oil or similar lubricant.

Another object is to provide a piston having wearing rings in which the rings may be rotated relative to the piston to obtain maximum wear therefrom and without disturbing the assembled relationship of the piston, piston rod and crosshead.

A further object is the provision of such a piston which is simple in construction and easily and inexpensively maintained.

Other objects will become apparent from the following description and accompanying drawings which illustrate preferred embodiments of the invention and in which similar numerals refer to similar parts.

Fig. 1 is a sectional elevation of a cast iron piston constructed in accordance with the practice of the invention, Fig. 2 is a transverse view taken along the line 2—2 of Fig. 1 looking in the direction indicated by the arrows,

Fig. 3 is a sectional elevation of an aluminum piston constructed in accordance with the practice of the invention, and

Fig. 4 is a transverse view taken along the line 4—4 of Fig. 3 looking in the direction indicated by the arrows.

Referring to Fig. 1 of the drawings, the invention is shown as applied to a piston assembly 20 reciprocable in a horizontally disposed cylinder 22 which is of the non-lubricated type. The piston assembly 20 comprises a piston rod 24, a piston body section 26 rigidly mounted on the rod 24, a carrier section 28 slidably mounted on the body section 26 and adapted to be rotated relative thereto, and a wearing element 30 carried by the carrier section 28 and clamped immovably between said section and the body section 26. In order to assure adequate lubrication between the piston assembly and the cylinder, the element 30 is formed of a material having self-lubricating qualities to slidably support the piston in the cylinder.

Referring in greater detail to the construction of the piston assembly 20, the piston body section 26, which in this case is a simple cast iron body, is rigidly mounted on the rod 24 to form a unitary piston structure. To this end the portion 32 of the rod 24 lying within the body 26 is of reduced diameter and forms at the juncture thereof and the rod proper a shoulder 34 which seats against the outer end of the body 26. The free end of the rod portion 32 is threaded to receive a slotted nut 36 which seats against the inner end of the body for clamping it securely against the shoulder 34.

The wearing element 30 comprises a pair of split wearing rings 38 of graphitic carbon which are mounted on the carrier section 28 and slidably fit the cylinder bore for supporting the piston assembly 20 substantially coaxial therein. The self-lubricating qualities of the carbon

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wearing rings 38 provides ample lubrication resulting in a minimum of cylinder wear without resorting to the use of oil lubricants.

The carrier section 28 locates the wearing rings 38 in spaced relation to each other and positions them relative to the piston body 26. For this purpose, the carrier section 28 includes a carrier 40 which is slidably rotatable on the body 26 and forms therewith an annular groove 41 to support the wearing rings 38. The carrier 40 has surfaces 42 and 43 which define the bottom and one side, respectively, of the groove 41 while the body 26 contains a surface 44 which defines the other side of the groove opposite the side 43. The split rings 38 closely fit the bottom 42 of the groove 41 and seat against the sides 43 and 44 thereof. The rings 38 are held against movement toward each other by a spacer ring 45 which seats thereagainst and slidably fits the bottom 42 of the groove 41. The spacer ring 45, in turn, carries a pair of conventional graphitic carbon piston rings 46 and a pair of expander rings 48 therefor.

The carrier 40 serves the added purpose of clamping the wearing rings 38 and the spacer ring 45 immovably between the carrier and the piston body 26. To accomplish this, the carrier 40 is rigidly secured to the body 26 by longitudinally disposed screws 50 which pass through the carrier 40 and threadedly engage the body 26. It is to be understood that, although four equally-spaced screws are used in this case, as shown in Fig. 2, three or six screws could also be practically employed for the same purpose.

Inasmuch as the cylinder 22 is horizontally disposed, the force of gravity constantly pulling the piston assembly 20 downwardly against the bottom of the cylinder bore causes the greatest amount of wear to occur on the lower side of the wearing rings 38, which accordingly drops the piston in the cylinder bore as the rings are worn. When a set of wearing rings 38 has worn to such an extent that the piston body 26 and carrier section 28 approach the bottom of the cylinder bore, it is desirable to shift the rings 38 relative to the piston body 26 to place a substantially unworn portion of the rings 38 at the lower side of the piston. In the present invention this may be easily done without rotating the entire piston assembly 20. It merely requires removing the screws 50 from the carrier 40 and the piston body 26 and rotating the carrier section 28.

The carrier 40, the wearing rings 38 and the spacer ring 45 including the piston rings 46 and expanders 48 are rotated ninety degrees in one direction relative to the body 26 to present a substantially unworn wearing ring surface to the bottom of the cylinder bore and thereby raise the piston assembly 20 to its original substantially coaxial position therein. The screws 50 are then replaced to clamp the rotated parts in the new position. This procedure may be repeated three times before replacement of the wearing rings is necessary. It will be obvious that if three or six screws 50 are used, the carrier section 28 and the wearing element 30 would accordingly be rotated at 120° and 60° intervals, respectively.

Additional wear from the rings 38 may be obtained by placing shims between the rings and the bottom of the groove 41 to expand the rings and force them radially outward from the carrier 40. However, in order to obtain maximum wear from a pair of wearing rings it is preferable to employ segmented rings which may be accordingly shimmed a great many times before replacement is required.

It will be seen that, in view of the fact that the carrier 40 encircles the nut 36, adequate clearance is provided therebetween so that the carrier section 28 may be easily removed for inserting shims in the groove 41 or replacing the wearing rings 38 without disturbing the

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assembled position of the nut 36 and the body 26 on the rod 24. Moreover, such clearance facilitates the rotation of the carrier section 28 to a new angular position relative to the piston body 26 to introduce a virtually unworn wearing ring surface to the bottom of the cylinder bore.

Conversely, by merely removing the nut 36, the whole piston assembly 20 may be removed from the rod portion 32 for inspection or replacement without altering the existing angular relationship between the carrier section 28 and the body 26.

Fig. 3 illustrates a modified form of the convention applied to a cast aluminum piston body 26'. All parts corresponding to those in Fig. 1 have the same numerals with the addition of a prime (').

In this construction of a piston assembly 20' reciprocable in a cylinder 22', the aluminum piston body 26' is partially supported on the piston rod 24' by a steel sleeve 52 slidably fitted in one end of the body 26' and having an internal taper which matches a tapered portion 54 of the rod 24'. The body 26' also includes a central portion 55 which slidably fits the reduced portion of the rod 24' adjacent the small end of the tapered portion 54 and abuts one end of the sleeve 52. The body 26' is rigidly secured to the rod 24' by means of a nut 36' which is threaded on the free end thereof and bears against the opposite end of the central portion 55 to clamp it against the sleeve 52. Such an arrangement permits free thermal expansion of the body relative to the rod.

In this form of the invention the carrier section 28' comprises a two-piece carrier which positions the wearing rings 38' and clamps them in place. For this purpose, the carrier forms with the body 26' an annular groove 41' and includes a spacer sleeve 56 which is slidably rotatable on the body 26' and supports the wearing rings 38' and a spacer ring 45'. The carrier also includes a closing ring 58 which is slidably rotatable on the body 26'. The spacer sleeve 56 has a surface 42' which defines the bottom of the groove 41', the closing ring 58 has a surface 43' which defines one side of the groove and the body 26' contains a surface 44' which defines the other side of the groove opposite the side 43'. The rings 38' closely fit the bottom 42' of the groove 41' and together with the spacer ring 45' are clamped immovably between the closing ring 58 and the body 26' by screws 50' which pass through the ring 58 and an inverted flange 60 on the spacer sleeve 56 and threadedly engage the body 26'. Resilient washers 62 are assembled on the screws 50' between the ring 58 and the flange 60 to prevent longitudinal sliding of the spacer sleeve 56 on the body 26' during the reciprocation of the piston assembly 20' in the cylinder 22'.

It will be noted that solid wearing rings 38' could be used in the modified arrangement shown in Fig. 3. However, in view of the previously mentioned advantage it is preferable to employ the segmental type of wearing rings.

Thus it will be seen that, regardless of which form of the invention is utilized, the piston assembly assures quick and easy adjustment and replacement of the wearing rings and eliminates the necessity of disturbing the assembled relationship of the piston body, rod and crosshead. Moreover, in view of the fact that rotation of the piston and rod relative to the crosshead is not required to provide new bearing surfaces for the piston each time the wearing rings become worn, smaller end clearances

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between the piston and the cylinder heads are permitted. Finally, the relatively open piston body construction affords the use of sound and accurately machined body castings which are adaptable to a wide range of piston sizes.

I claim:

1. A piston assembly adapted to be attached to a piston rod for reciprocation in a cylinder, comprising a main body section having a portion of approximately the cylinder diameter, the body section being rigidly mounted on the rod, a complementary carrier section forming with the body section a cavity, a pair of wearing rings in said cavity cooperating with said cylinder to centralize the body section therewithin, a spacer ring in the cavity interposed between said wearing rings, sealing rings in said spacer ring, and clamping means to hold said carrier section rigidly on said body section, all of said rings and spacer section being supported on said carrier in symmetrical position longitudinally of the piston and with respect thereto, and being removable as a unit from said body section.

2. A piston assembly adapted to be attached to a piston rod for reciprocation in a cylinder comprising a main body section having a portion of approximately the cylinder diameter, the body section being rigidly mounted on the rod, a complementary carrier section forming with the body section a cavity, a pair of wearing rings in said cavity cooperating with said cylinder to centralize the body section therewithin, a spacer ring in the cavity interposed between said wearing rings, sealing rings in said spacer ring, and clamping means to hold said carrier section rigidly on said body section, all of said rings and spacer section being supported on said carrier in symmetrical position longitudinally of the piston and with respect thereto, and being removable as a unit from said body section, said clamping means consisting of evenly spaced bolts which upon removal permit rotation and reclamping of the carrier section in changed angular relation to the body section.

3. A piston assembly adapted to be attached to a piston rod for reciprocation in a cylinder comprising a main body section having a flange portion of approximately the cylinder diameter, the body section being rigidly mounted on the rod, a complementary carrier section forming with the body section a cavity, a pair of wearing rings in said cavity cooperating with said cylinder to centralize the body section therewithin, a spacer ring in the cavity interposed between said wearing rings, sealing rings in said spacer ring, and clamping means to hold said carrier section rigidly in position on said body section and cooperative with said body flange portion to hold said wearing rings immovably in position, all of said rings and spacer section being supported on said carrier section in symmetrical position longitudinally of the piston and with respect thereto and being removable as a unit from said body portion, said clamping means consisting of evenly spaced bolts which upon removal permit rotation and reclamping of the carrier section in changed angular relation to the body section.

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