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PACKED PISTON FOR HIGH-PRESSURE CYLINDERS

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Fig. 1.

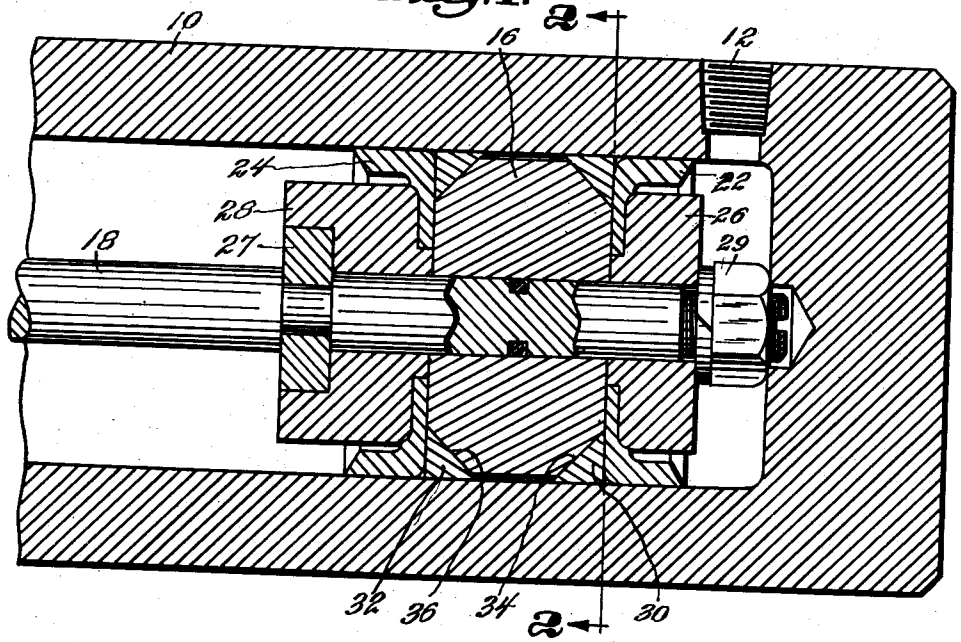
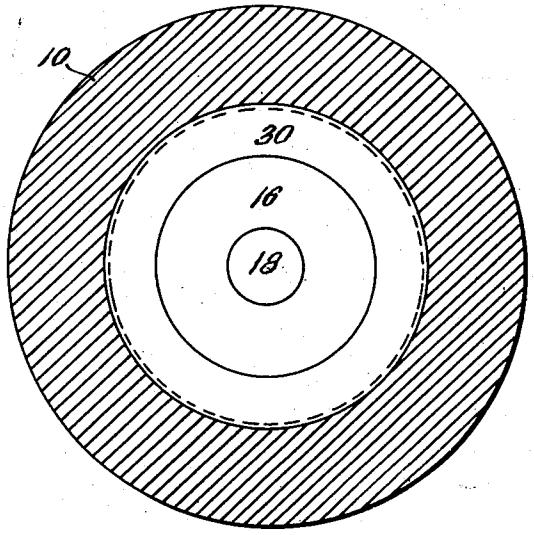


Fig. 2.



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PACKED PISTON FOR HIGH-PRESSURE CYLINDERS

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3 Claims. (Cl. 309—4)

1

The present invention relates to improvements in packed pistons for use in high pressure cylinders.

It is the principal object of the invention to provide for use in a high pressure power cylinder a novel and improved packed piston assembly of the general type which comprises a lip type packing of a resilient material, a piston head on the end face of which the packing is supported and secured, and a backing-up element for the packing, these parts in accordance with the invention being constructed and arranged in a novel manner to support hydrostatic pressures far in excess of those previously considered practical for conventional cup or U-shaped packings, and with improved wearing quality and long life for the packing.

In carrying out the invention the lip-type packing is utilized in combination with a backing-up ring which is of substantially triangular cross-section and rides against a beveled surface formed on the outer edge of the piston face so that the backing-up element will be forced outwardly against the cylinder wall as pressure is applied. The backing-up element associated with the lip-type packing is arranged to engage against the cylinder wall with a pressure which is automatically adjusted in accordance with the pressure within the cylinder to maintain for any conceivable variation of applied pressure a perfect fit between the backing-up element and the cylinder wall.

The invention will be more particularly described in connection with the accompanying drawing in which Fig. 1 is a sectional view of a power cylinder and associated double acting packed piston illustrating in a preferred form the several features of the invention, and Fig. 2 is a sectional view taken on a line 2—2 of Fig. 1.

Referring to the drawing, a power cylinder is designated at 10 having a port 12 and a second port not shown at opposite ends for alternately admitting under pressure and exhausting the fluid pressure medium from the two ends of the cylinder. A double acting piston is provided comprising a piston head 16, and a connecting rod 18 which passes outwardly through an aperture, not shown, in one end of the cylinder. Two cup-shaped packings 22 and 24, which may be conventional leather packings with metal retainers 26, 28, are rigidly secured to the opposite end faces of the piston head 16, being tightened together between a split thrust washer 27 and a tightening nut 29 on the piston rod 18.

In accordance with the invention, the leather

2

packings 22, 24 are further supported along the point of contact between the piston and cylinder wall by means of two backing-up ring elements 30, 32, each of which is formed as a continuous unbroken band substantially triangular in cross-section and having one face thereof which bears against the piston wall, a second face which lies in a plane transverse to the cylinder providing a support for the respective packing, and the third face which is arranged to bear against a correspondingly beveled surface on the outer edge of the piston. The bevel surfaces at the two ends of the piston are indicated respectively at 34 and 36, are frusto-conical in shape, and each has a slope of approximately 45° from the plane of the end face of the piston. It will be understood that this angle is adjustable to suit particular conditions. In the illustrated embodiment of the invention, a finite clearance is provided between the outer surface of the piston and the cylinder, which may be in the order of .01 inch to .02 inch. The ring backing-up elements 30, 32, as clearly shown in the drawing, have a cross-sectional area which is substantially equal to the area of the cut-out edge portion of the cylinder.

When a fluid medium which may, for example, be water or oil is introduced into the cylinder under high pressure, the lip of the packing 22 is forced outwardly against the wall of the cylinder to form a seal. The endwise thrust of the hydrostatic pressure tends to distort the packing so that it is pressed exactly to the shape of the supporting seat and when the pressure is in excess of the normally rated capacity of the packing, there is a tendency for the packing material to be extruded through any crack or crevice, however minute, which it may find between the seating end surface of the piston and the cylinder wall.

The backing-up ring elements 30, 32, in accordance with the present invention, are so shaped and of a material having a high degree of elasticity so that the pressure exerted upon the ring by the contacting portions of the packing will cause the associated backing-up ring to expand outwardly on its beveled surface against the side wall of the cylinder, thus providing a perfect fit between these parts. In the illustrated embodiment of the invention, it is contemplated that the cylinder wall and backing-up ring will be composed of complementary friction eliminating materials. As shown, the backing-up rings are of brass, and are in contact with the cammed surface of a steel piston and with the internal surface of a steel wall cylinder.

In the operation of the device and assuming

the piston is at the extreme right hand end of its travel as shown in Figure 1, port 12 is connected to pressure and the other port is connected to exhaust. The hydrostatic pressure which may be, for example, from 2,000 up to 25,000 pounds per square inch is now built up in the right hand end of the cylinder against the piston packing 22. In accordance with the usual operation of such packings, the lip portion is forced outwardly against the wall forming a seal. The engaging portions of the packing bear against the supporting face of ring element 30 with the same pressure in terms of pounds per square inch as that exerted upon the packing. The backing-up ring 30 now tends to be forced outwardly on the supporting beveled surface 34 so that the ring is engaged tightly against the surface of the piston. In this way a perfect seal is formed between the brass ring and the cylinder wall which prevents any possibility of extrusion of the relatively weaker pliable packing material between the wall and the piston. With the arrangement described, the outward pressure exerted by the ring element 30 against the cylinder wall is increased substantially in direct proportion to the increase of the hydrostatic pressure exerted against the end face of the piston 16.

The construction and arrangement of parts has the specific advantage that the outward thrust is at all times adequate to maintain a perfect seal for any given pressure and the increase in the frictional component between the ring element and cylinder wall is at the same time held to a minimum value which will avoid the possibility of freezing of the parts or of any scoring of the cylinder wall. The backing-up ring elements 30 and 32 as here employed act as guiding lands for the piston which acts automatically and with increased efficiency as the hydrostatic pressure is increased to maintain the piston in a perfectly fitted centered position in the cylinder.

It will be understood that the ring elements 30, 32 are further constructed and arranged to be fully elastic within the range of expansion required, and will have a substantially faster recovery rate than the cylinder wall to avoid any possibility of freezing or jamming of either of the backing-up rings when the pressure is released from the cylinder.

The invention having been described, what is claimed is:

1. A packed piston for a high pressure cylinder having an internal cylindrical piston bearing surface which comprises a piston head of cylindrical shape of a diameter to provide a substantial clearance between the piston head and cylinder and having a transverse end face providing a packing thrust support and with the edge of said face cut away to provide a frusto-conical cam surface, a lip-type packing of resilient material, means rigidly securing the packing against the end face of the piston, and an unbroken backing-up ring element fitted to said frusto-conical cam surface having a triangular cross-section substantially filling in the cut-away portion of the piston, said ring element being chosen of a material, and so proportioned to have a higher degree of elasticity than the cylinder and a low component of friction with relation to the contacting cylinder and piston surfaces, whereby variations in the hydrostatic pressure exerted against the packing causes the ring element to expand and contract with the cylinder wall in response to said pressure variations to provide a packing extrusion tight fit between the cylinder wall and the piston for any applied pressure.

2. A claim according to claim 1, in which the piston is formed at each end to have a transverse end face providing a packing thrust support and with the edge of each of said faces cut away to provide frusto-conical cam surfaces, and unbroken backing-up ring elements fitted respectively to said frusto-conical cam surfaces, each element having a triangular cross-section substantially filling in the cut-away portion of the piston.

3. A packed piston for a high pressure metal wall cylinder having an internal cylindrical piston bearing surface, which comprises a piston head of cylindrical shape of a diameter to provide a substantial clearance between the piston head and cylindrical bearing surface and having a transverse end face providing a packing thrust support and with the edge of said face cut away to provide a frusto-conical cam surface set at substantially a 45° angle with relation to the end face, a lip-type packing of resilient material and a metal retainer for said packing, means rigidly securing the packing including the retainer aganst the end face of the piston, and an unbroken backing-up ring element fitted to said frusto-conical cam surface of a triangular cross-section substantially filling in the cut-away portion of the piston, said cylinder and ring element being chosen of materials and so proportioned to provide in the ring element a relatively higher degree of elasticity than the cylinder and a low component of friction with relation to the contacting cylinder surface, whereby variations in the hydrostatic pressure between 2,000 and 25,000 pounds per square inch exerted against the packing causes the ring element to expand and contract with the cylinder wall in response to pressure variations to provide a packing extrusion tight fit between the cylinder wall and piston for any said applied pressure.

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