This invention relates to packing or plunger rings, and more particularly, to ring and spacer elements adapted for use with plungers of oil well pumps.

The packing or plunger rings commonly employed with oil well pump plungers are subject to severe wear conditions, and must seat and seal with the enclosing barrel against high pressures, in order to perform with efficiency. While a tight fit between rings and barrel is essential on the upward pumping stroke, the same tight fit impedes the downward return stroke of the plunger, placing undue strain on the sucker rods even to the point of occasional breakage, and resulting in a minimum and often unsatisfactory bottom hole stroke.

It is a primary object of the present invention to provide in a pump, plunger rings adapted to seat and seal tightly on the lifting stroke, but to fail freely on the down-stroke, whereby maximum pumping efficiency is attained.

A further object of the invention is to provide an automatically expanding pump plunger ring, self-centering and adapted to exert pressure equally in all radial directions.

A further object is to provide in oil well pumps, plunger rings effecting a better seal than heretofore possible, whereby shorter plungers incorporating fewer rings may be utilized. A related object is to provide pump plunger rings adapted to maintain superior seal in spite of variations in barrel diameter, wear and the like.

Yet another object is to provide in a novel plunger ring and spacer unit, means on the spacer to cushion the ring, and to trap sand and grit.

Further objects of the invention will be in part obvious and in part pointed out hereinafter.

The invention and the novel features thereof will best be made clear from the following description and the accompanying drawings, in which:

Figure 1 is a perspective view of a preferred plunger ring and spacer unit constructed according to the present invention;

Figure 2 is a top plan view, on reduced scale, of the unit of Figure 1;

Figure 3 is a side elevational view, with ring and spacer separated, of the unit of Figures 1 and 2;

Figure 4 is an elevational view, partly in section, of a portion of a pump barrel and plunger provided with a plurality of ring and spacer units of the invention;

Figure 5 is a sectional view of a modified plunger ring and spacer unit, involving merely one beveled surface on each element;

Figure 6 is a top plan view of a modified spacer element, provided with an angular cushioning groove in the upper beveled surface thereof, and

Figure 7 is a sectional view of the spacer element of Figure 6.

Referring to the drawings in detail, particularly Figures 1 to 4, a preferred embodiment of the invention comprises a plunger ring indicated generally as 10, including an annular body 11. The ring body may be constructed of any suitable resilient material, a hard thermosetting plastic of the nature of Bakelite being preferred. The ring body may be reinforced by laminations or otherwise, and impregnated with graphite to reduce its coefficient of friction.

To permit expansion of the ring, the body 11 is step cut at 12 to provide a step joint, whereby overlapping oppositely directed sealing tongues 13 and 14 are formed. At the end of each sealing tongue may be provided a space or cut-away section such as 15 and 16, whereby the ring may be contracted as well as expanded from normal unstressed condition. As a principal feature of the invention, the upper and lower surfaces 17 and 18, respectively, of the body are beveled rather than planar, each surface sloping outwardly and downwardly to coincide substantially with a cone coaxial with the body.

To support and coat with the plunger ring a metal spacer 19 is provided, comprising an annulus 20 and a collar 21 extending upwardly from the inner portion thereof. The spacer 19 is adapted for interfitting relationship with ring 10, the collar fitting loosely within the ring, and the upper surface 22 of annulus 20 being beveled to correspond to the lower surface 18 of the ring. That is, when the ring and spacer are cooperatively arranged, as in Figure 1, the ring surface 18, mates with and bears against the adjacent annulus surface 22. The lower surface 23 of annulus 20 is also beveled, to correspond to the upper surface 17 of the ring, to permit coaction of a plurality of ring and spacer units, as will presently appear. The depth of the spacer collar 21 slightly exceeds the depth of the inner surface 24 of the ring.

A plurality of ring and spacer units operatively assembled in a typical oil well pump are illustrated in Figure 4. As there shown, the assembly is contained within a barrel 25. The pump plunger 26 is adapted to be reciprocated within the barrel, and encircling the plunger 26 are a plurality of the ring and spacer units previously described. As will readily be understood by those skilled in the art, the pump operates to raise oil to the surface on the up-stroke of plunger 26, the plunger moving downwardly through the oil and its down-stroke to permit a quantity of oil to pass thereby. A plurality of spacers 19 fit closely about the pump plungers, and are suitably supported thereon for movement therewith. As clearly shown in Figure 4, each spacer supports about its collar a ring 10.

The rings 10 fit loosely in normal condition about the spacer collars, and may also fit loosely within the pump barrel, whereby assembly is facilitated, as the rings need not be precompressed for insertion into the barrel. On each up-stroke of the plunger, the beveled upper surface 22 of each spacer bears against the matching lower surface 18 of the associated ring, causing the ring to spread outwardly into close-fitting, tightly-sealing relationship with the barrel wall. This outwardly spreading effect is assisted also by oil pressure exerted against the inner surface 24 of the ring.

On each pump's stroke, then, each ring makes a perfect seal with the barrel, effecting a pumping efficiency heretofore not known. By reason of the conical configuration of the mating ring and spacer surfaces, the rings are self-centering, and maintain an excellent seal even though the barrel diameter may vary from place to place. Equal pressure is exerted in all radial directions, and ring wear is evenly distributed about its periphery and does not affect sealing efficiency.

On the down-stroke of the plunger, the rings are relieved of the spreading force previously described, whereupon, due to their inherent resilience, they return to normal position spaced from the barrel wall, and the entire assembly falls freely, the rings exerting no appreciable frictional drag on the barrel. Additionally, the beveled lower surface 23 of each spacer will contact the upper surface 17 of the ring below, positively contracting the...
ring to insure free fall of the plunger. The advantages of this construction and functioning will be obvious, the freely falling plunger making possible a bottom hole stroke of maximum length, and reducing the power required for pumping to a minimum.

A modification of the invention is illustrated in Figure 5, wherein the ring 30 and spacer 31 are constructed as previously described, with the exception that the upper surface 32 of the ring and the lower surface 33 of the spacer are normal to their axes, rather than beveled. The upper surface 34 of the ring and the upper surface 35 of the spacer are correspondingly beveled as in the previous embodiment, whereby the ring is forcibly expanded on pumping strokes into contact with the barrel. On return strokes, the outward force, effecting the beveled surfaces is relieved, and the ring contracts of its own resilience to permit a free, unimpeded downward stroke. As will be apparent, this modification is of simpler and, accordingly, less expensive construction.

In pumping, the rings move up and down between spacers with each change in plunger direction, which in some cases occasions considerable shock effect against the plunger and the associated sucker rods. This effect may be obviated in part, it has been found, by providing a cushioning groove in the upper surface of each spacer. A spacer embodying this feature is illustrated in Figures 6 and 7, wherein a spacer 19 is provided with an annular groove 36 in the upper surface 22 thereof. By way of example, the groove 36 may be semi-circular in cross section, constructed to a radius of \( \frac{3}{8} \) of an inch. The groove and the oil normally contained therein not only exhibit a cushioning effect upon change from downward to upward stroke, but have been found to be an effective trap for fine sand, grit and the like. Such abrasive particles, which would otherwise cause wear between spacers and rings, tend to collect and remain in the groove, whereby the life of the ring and spacer units is greatly extended.

The annularity of the bevel employed to insure sealing of the plunger rings against the barrel may be varied within wide limits. In the case of a deep well, wherein the load on the rings will be large, relatively less bevel may be provided, a bevel of perhaps 10° from a plane normal to the axis being adequate. In the case of shallow wells, wherein the load is lighter, correspondingly more bevel, ranging up to 45° or more, may be found to create the desired seal more effectively. Obviously, the bevel of adjacent surfaces must be substantially identical for best results. That, is, the upper surface of a spacer and the lower surface of the associated ring should be beveled at the same angle. Similarly, if the lower surfaces of the spacers and the upper surfaces of the rings are beveled, they should be beveled at identical angles. Normally, if the rings and spacers are beveled both above and below, the angle of all beveled surfaces will be the same, although this is not essential.

As will appear, the beveled surfaces of rings and spacers need not be true conic sections, but may be slightly curved or otherwise formed, for example in the nature of a section of a sphere. It is essential only that the beveled surfaces be axially symmetrical, and slope outwardly and downwardly in the manner of a conic section.

It will thus be seen that there has been provided by this invention a structure in which the various objects hereinafter set forth, together with many practical advantages, are successfully achieved. As various possible embodiments may be made of the mechanical features of the above invention, all without departing from the scope thereof, it is to be understood that all matter hereinafter set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A pump plunger ring and spacer unit comprising an annular ring, said ring having a step joint including overlapping sealing tongues, and an annular metal spacer, said spacer including a solid annulus having a peripheral collar extending axially from the inner edge thereof, said ring loosely enclosing said spacer collar, the depth of said spacer collar slightly exceeding the depth of the adjoining surface of said ring, the upper and lower surfaces of both said ring and spacer being correspondingly beveled to coincide substantially with the surface of a cone coaxial with said ring.

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