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PIN END THREAD PROTECTOR FOR SUCKER RODS AND THE LIKE

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FIG. 2

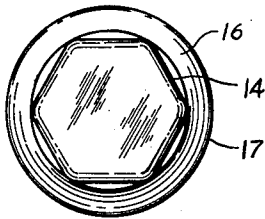


FIG. 4

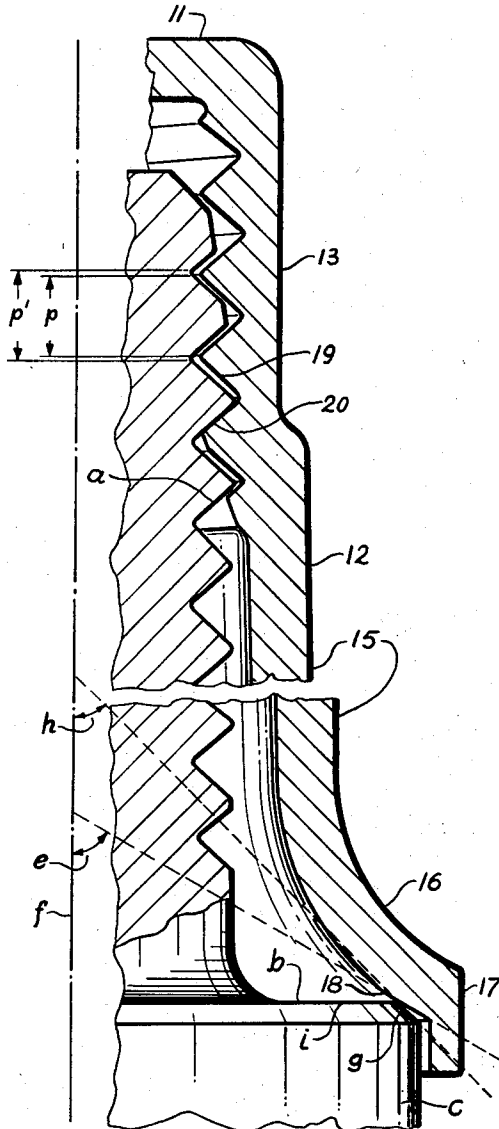


FIG. 1

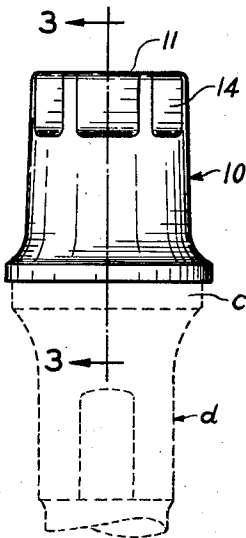
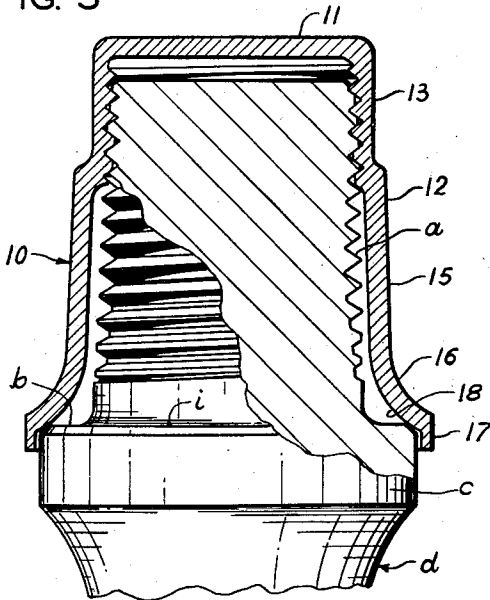


FIG. 3



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PIN END THREAD PROTECTOR FOR SUCKER RODS AND THE LIKE

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The present invention relates to thread protectors, and particularly to protecting pin-ended oil well sucker rods under extreme conditions of moisture, painting and heat. These extreme conditions are often combined, as when sucker rods, with the protectors attached to the pin ends, are immersed in paint and then conveyed to a drying oven.

The advantages of using a protector die-cast of zinc, or some other metal softer than steel, are obvious. Such die-castings are readily produced, are inexpensive and economical for single-use applications. Being softer than steel, they will seal tightly against steel, and also protect the threads from damage by impact.

A difficulty which heretofore hindered the general use of such die-cast protectors, arises from the fact that the coefficient of thermal expansion of zinc die-casting alloys is several times as great as that of steel. The heat of baking a protective paint coat causes the protector to expand much more than the steel rod end, tending to open the seal and, aided by agitation attendant handling, to loosen the protector.

The general purpose of the present invention is to overcome these prior difficulties, and to provide a die-cast thread protector, preferably zinc, which will avoid impact damage to threads and can be inexpensively produced, which will nevertheless seal against paint and moisture under extreme conditions of heat and impacts of handling.

A further purpose includes providing a protector which not only protects the threads but also seals the shoulder which joins the threads to the larger diameter end portion of the rod.

A still further purpose is to provide a metal rod end protector sufficiently deformable to seal securely, despite difference in coefficients of thermal expansion between the protector material and the rod to be protected.

These and other objects herein disclosed are accomplished in the manner set forth in the following specifications, as depicted in the drawings, in which:

Figure 1 is a side elevation of a protector for pin-ended sucker rods, embodying the present invention, the dashed lines showing a rod end including its threaded pin end, shoulder, and portion adjacent thereto.

Figure 2 is a top view of the end protector of Figure 1.

Figure 3 is an enlarged sectional view taken along line 3—3 of Figure 1, showing the protector in place on the rod end.

Figure 4 is a further enlarged fragmentary view by which the working principles of the present invention are illustrated.

Referring to the figures by the detail parts and the numbers assigned to them, the problem is to protect the threads *a* and the surface of the annular shoulder *b* of the diametrically enlarged rod end *c* of a pin-ended sucker rod generally designated *d*. For this purpose I provide a protector in the form of a cap generally designated 10 having a closed upper end 11, a cap body portion generally designated 12 including (adjacent the closed end 11) an internally threaded part 13, the outer surface of which is generally hexagonal and provided with wrenching flats 14; and an unthreaded part 15 of slightly greater inner diameter. The unthreaded part 15 may be thought of as the skirt, having along its lower portion a flared part 16 which is radially enlarged and terminates in a rim 17 whose inner diameter is somewhat

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greater than the diameter of the enlarged end *c* of the sucker rod *d*.

Inwardly adjacent the rim 17, the flared part 16 has an inner sealing surface 18, formed at an angle *e* of approximately 60° to the central axis *f* of the thread protector, which is the axis about which the threads of the threaded part 13 are formed. This angularity is illustrated in the enlarged fragmentary view, Figure 4, which also shows that the enlarged rod end *c* has a bevel *g* formed at about 45° to the surface of the annular shoulder *b*, which is itself perpendicular to the central axis of the rod *d*. Since this axis coincides with the central axis *f* of the protector, it is not separately shown. However, the 45° bevel angle *h* is projected over to the central axis *f*, for comparison with the 60° angle *e* of the inner sealing surface 18 of the flared part 16.

The threads *a* of sucker rods such as the rod *d* are generally machined to a pitch of 10 threads to the inch, which pitch is designated *p'* in Figure 4. Instead of matching the thread pitch, I provide within the threaded part 13 only a few protector threads 19, formed at a pitch *p* which is less than the pitch *p'*, say 10½ threads to the inch. By providing only a few threads 19 in the protector end, and beveling the first one or two of these (those nearest the rim edge of the protector) I achieve the following result:

Instead of providing for a substantial amount of thread area in contact, as would be conventional, I intend in the present invention that the portion of the helical path of the threads which makes contact shall be limited to a small contact area designated 20. It is convenient to speak of such limited contact area as having "one thread in contact," as would appear from the sectional view of Figure 4. If the entire helical thread path be visualized, however, it will be realized that there is not "one thread in contact" but rather, a limited area which depends partly upon the deformation of the protector.

It is apparent that as the protector is tightened in place, the compression acting through the unthreaded part 15 will bring about tight bearing contact against the contact area 20. The small contact area 20 minimizes friction and permits a greater part of the wrenching torsion to be absorbed by compression in the unthreaded part 15, which compression itself helps to hold the protector in place. Other threads between such "thread in contact" and the closed end of the protector are held successively farther from bearing contact by virtue of the lessened pitch of the protector threads *p* as compared with the sucker rod threads *p'*.

The area in contact would be greatly increased were the protector to expand relative to the sucker rod. This is precisely what happens, due to the protector's greater coefficient of thermal expansion. On heating to bake the paint, the contact area 20 increases greatly, exerting a tighter compressive and friction force which serves to bind the protector tightly in place.

The inner sealing surface 18 is presented against the inner bevel edge *i* which forms the edge of the rod shoulder *b*, and is wrenched until it deforms somewhat. This provides a close metal-to-metal seal, provided it be not disturbed by expansion of the protector relative to the rod.

I effect this seal by flaring the unthreaded part 15, and particularly the flared part 16 thereof out to the rim 17, so that the inner sealing surface 18 may ride back and forth on the bevel *g* during heating and cooling, without, however, breaking the seal. This result follows from proportions wherein the vector sum of deflections of the sealing surface 18, both axial and radial, is roughly along the line of the 45° angle *h*. In any event, the radial expansion of the rim 17 which might break the seal is overcome by axial expansion of unthreaded part 15.

The combination of features herein described, and which contribute to the success of the present invention, are believed to be entirely novel. Unlike other devices wherein threads of differing pitch have been combined, the present invention does not rely on developing a tension between the threads of the protector which have the smaller pitch p . To the contrary, few threads are used, and tolerance is provided between the threads to limit the thread contact to a small area of bearing, to be increased on heating.

Although the present invention is not limited to a single embodiment, material or process, it is obviously advantageous to be able to utilize the zinc die-casting alloys herein. Their softness relative to steel gives assurance against impact damage which might cause areas of stress concentration, bringing about premature failure of the sucker rod connection in fatigue. Other materials, especially those suitable for casting, may be employed; the coefficient of thermal expansion of the protector material should, however, exceed that of the material forming the sucker rod.

Certain adaptations and changes will occur to those skilled in the art. In some instances, such changes may sacrifice a part of the advantage of the present invention, without departing from the scope hereof. Accordingly, the present invention is not to be construed narrowly, but fully coextensive with the scope of the claims which follow.

I claim:

1. In combination, a sucker rod having an externally threaded pin end and a shoulder thereadjacent, together with a thread protector formed of metal having a greater coefficient of thermal expansion than such rod, the protector comprising a cap having a threaded body portion and a closed end, together with a skirt having such radius as to bear against the rod shoulder when the protector is applied to the pin end, the threads of the body portion having a lesser pitch than the threads of the pin end of said rod whereby the portion of the thread path in contact will be limited, the skirt being compressed on tightening the protector and further compressed by increasing temperature thereafter, such compression being reacted in bearing over the portion of the helical path of the thread in contact, the relative expansion of the protector on heating causing an increase of the thread path area in contact and thereby effectively tightening the grasp of the protector at elevated temperature.

2. In combination, a steel rod having an end portion and a threaded pin portion of lesser diameter than the end portion and joined thereto by an annular shoulder, together with a thread protector comprising a cap formed of material having a greater coefficient of thermal expansion than steel, the cap having a closed end, a body portion threaded internally adjacent said end, whereby to engage the threaded end portion of such rod remotely from its shoulder, and an unthreaded body portion of greater internal diameter next adjacent, said unthreaded portion being presented against such shoulder and on tightening of the protector to be stressed in compression between such shoulder and the region of thread engagement, the thread pitch of said body portion being less than the rod thread pitch whereby the area of the thread path in bearing contact is lessened, said area in bearing contact being increased on heating whereby the protector is held more tightly at elevated temperatures.

3. The combination as defined in claim 2, the thread pitch of said body portion being $10\frac{1}{2}$ threads per inch, such rod thread pitch being 10 threads per inch.

4. The combination of a steel rod having a threaded end portion and an annular shoulder thereadjacent having an outer edge, with a thread protector comprising a cap formed of material having a greater coefficient of thermal expansion than steel, the cap having a closed end, an internally threaded body portion adjacent said end engageable to the rod end portion; an unthreaded

body portion of greater internal diameter next adjacent, said unthreaded portion flaring outward to a rim whose inner diameter exceeds the outer diameter of such shoulder edge, the inner surface of said flaring portion adjacent the rim being presented sealingly against the edge of such annular rod shoulder, whereby, upon thermal expansion of the cap relative to such rod, the flaring portion will lengthen axially as it enlarges radially, thereby maintaining a seal between said inner surface portion and the edge of such rod shoulder.

5. The combination as defined in claim 4, the annular shoulder having an outer beveled edge, the said flared portion being formed at an angle to the thread axis greater than the angle of such beveled edge to the axis of such rod, whereby the force of such bearing contact is concentrated sealingly upon and against the juncture between such rod shoulder and such bevel.

6. The combination as defined in claim 4, the annular shoulder having an outer edge beveled at 45° to the rod axis, the angle of said flared portion in the region of bearing against the rod shoulder being 60° from the thread axis.

7. The combination as defined in claim 4, the protector being formed of zinc casting alloy, whereby a moisture-proof sealing contact between said flared part and the edge of such rod shoulder is obtained.

8. The combination as defined in claim 4, the thread pitch of said body portion being less than that of the rod pin end whereby the area of the thread path engageable in bearing contact is lessened, said area in bearing contact being increased on heating whereby the protector is held more tightly at elevated temperatures.

9. The combination as defined in claim 4, the thread pitch of said body portion being $10\frac{1}{2}$ threads per inch, such rod thread pitch being 10 threads per inch.

10. The combination of a steel sucker rod having a threaded pin and thereadjacent having an annular shoulder terminating in a shoulder edge, together with a thread protector comprising a cap formed of metal having a greater coefficient of thermal expansion than steel, the cap having a closed end, an internally threaded body portion adjacent said end, an unthreaded body portion of greater internal diameter next adjacent, said unthreaded portion flaring outward to a rim whose inner diameter exceeds the outer diameter of said sucker rod shoulder edge, the internal surface of said flaring portion adjacent the rim being presented sealingly against the edge of the sucker rod shoulder, whereby upon thermal expansion of the protector, its flaring portion will lengthen axially as it enlarges radially, thereby maintaining a seal between its said inner surface portion and the edge of said shoulder.

11. The combination comprising a steel sucker rod having a threaded pin end and a shoulder adjacent said pin end, together with a thread protector cap formed of material having a coefficient of thermal expansion greater than steel, an internal thread therein engaging the threads of the pin end and formed to a pitch less than the pitch of the threads of said pin end, and an integral skirt presented sealedly against the rod shoulder.

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