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2,808,301

PUMP PISTONS

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2 Sheets-Sheet 1

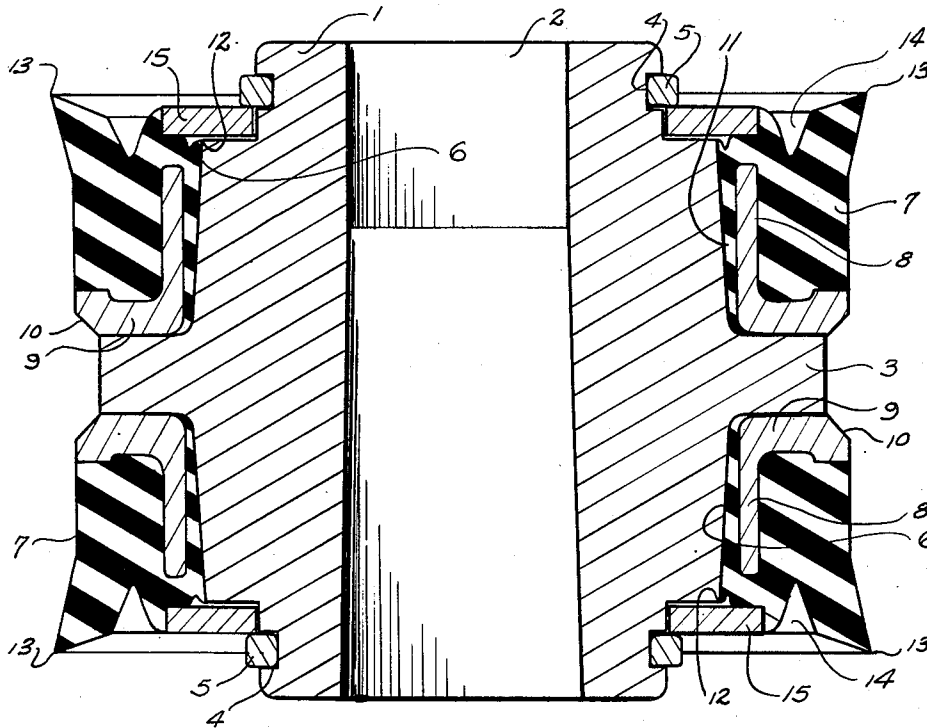


Fig. I

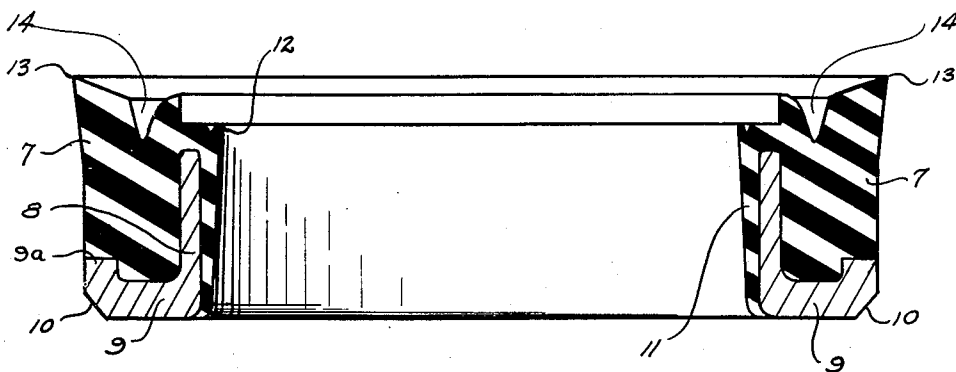


Fig. II

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2 Sheets-Sheet 2

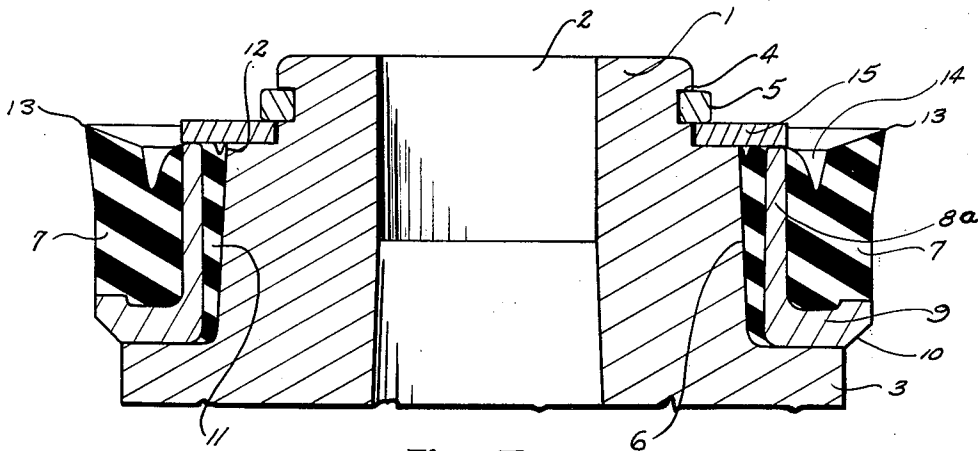


Fig. III

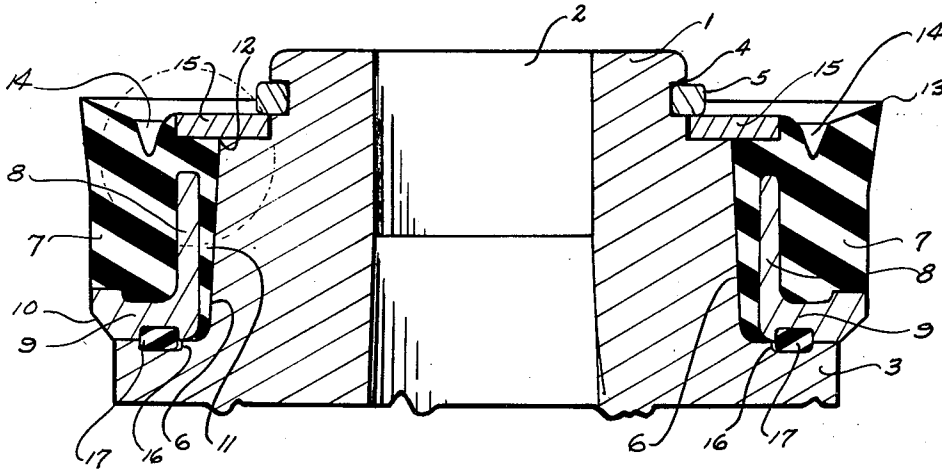


Fig. IV

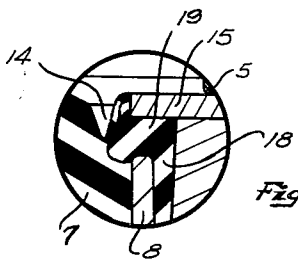


Fig. V

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PUMP PISTONS

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17 Claims. (Cl. 309—23)

This invention relates to pump pistons and, for purposes of illustration of its salient features, details elaborated upon will be those usually encountered in the actuation of the circulating media employed in the drilling of oil wells by the rotary method.

The invention relates to improvements in pump pistons such as disclosed in my United States Letters Patent 2,687,335. Improvements in pump pistons embodying my novel features will be readily understood by those skilled in the art from the following description together with the accompanying drawings wherein:

Fig. I is a half sectioned elevation of a preferred form of double-ended piston assembly.

Fig. II is a half sectioned elevation of a preferred form of a sealing member.

Fig. III is a modified form of a part of piston assembly.

Fig. IV is a modified form of Fig. III.

Fig. V is a modification of the area shown inside the dotted line circle of Fig. IV.

In the several figures like references indicate similar parts wherein: 1 is a piston body provided with suitable aperture 2 for receiving a conventional piston rod not shown, and having a medially disposed radial web 3, and a groove 4 for receiving snap ring 5, and a portion 6 which is a frustum of a cone concentric with the main axis of the body, and its base portion terminating adjacent to web 3, said outer construction being symmetrical about the plane of the transverse axis of web 3. 7 is a sealing member of rubber or some other resilient material bonded to and supported by a metal sleeve 8, said sleeve having a flanged portion 9 of greater diameter than web 3, and a portion of said flanged base being chamfered as at 10. A rubber-like sealing member 11 is carried by sleeve 8 on its inner diameter. Sealing members 7 and 11 extend upwardly along sleeve 8 and terminate in sealing lips 12 and 13 which effect sealing engagement respectively with the conical section of the piston body and the liner of the pump cylinder not shown. Annular recess 14 is formed between outer lip 13 and metal sleeve 8. 15 is a metal ring fitted about the extended ends of the piston body and is retained in operable position against sealing members 7 by snap ring 5. In Fig. IV web 3 is provided with an annular groove 16 adapted to receive sealing ring of rubber-like material 17 carried by flange 9 of the sleeve 8 opposite the rubber-like portion of seal member 7 for purposes more clearly set forth later herein. In Figs. I, II, and IV sleeve 8 terminates within the rubber-like material of seal member 7, whereas in Fig. III the sleeve 8a is shown as extending the full length of the material of sealing member 7.

The assembly and operation of my improved piston is as follows: sealing element assembly shown in Fig. II, and as appearing in the other figures in varying modifications, is molded by conventional techniques from rubber or other rubber-like resilient materials of selected physical characteristics as determined by the operating considerations under which the piston is designed to perform. Metal sleeve 8 is preferably formed of a suitable metal

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or other material which will provide good bearing qualities when presented to the face of the pump liner, resulting in a degree of protection to the more expensive liner not previously attained with conventional pistons. The inclusion of metal sleeve 8 in sealing member 7 allows the sealing member 7 to function with two zones of action present. That is, the seal member 7 has resilient material on the outer periphery of sleeve 8 which serves a function of sealing and wiping against the liner face and is aided in this function by presence of sleeve 8 in that, as pressures are generated by the piston and the resilient material tends to distort, forces of tension are produced caused by the bond of the resilient material to the sleeve which tends to prevent damaging distortion of the material. As the sleeve is shortened as shown in Figs. I, II, IV, and V, these forces of tension will be relatively decreased over those developed in the form as illustrated in Fig. III. In manufacture, I select the combination of elements most suited to the anticipated operating conditions to be encountered by the piston in service. In addition, the resilient material on the inner face of sleeve 8 serves primarily as a seal between the portion 6 of the piston body and the seal member 7 and is aided in this function by the isolation afforded it by sleeve 8. The portion of sealing member 7 which, after assembly upon the piston body 1, lies adjacent portion 6 of the piston body, is molded to an interference diameter with respect to portion 6, resulting in a wedged, fluid tight seal between the parts. This feature of my improved piston allows the sealing member 7 to adapt itself to piston bodies that have minor irregularities on conical portion 6 as might result from conditions of use or manufacture. While in the several figures body 1 has been shown with conically tapered portion 6 it is intended that, in one modification, this portion could be made in cylindrical form, interference fit of the sealing member 7 being made to accommodate this configuration. Assembly of the piston is complete following placement of metal ring 15 and snap ring 5. Fig. III illustrates one modification of sealing member 7 wherein the sleeve 8a is shown as extending the full length of the material of seal member 7. In this form the ring 15 rests directly upon the terminal end of sleeve 8a. In the other figures sleeve 8 is shown as terminating short of the end of seal member 7, said feature being taken full advantage of by causing the total vertical dimension of the piston body from the top of groove 4 to the base of web 3 to be less than the total vertical dimensional sum of sealing member 7, metal ring 15, and snap ring 5. Upon complete assembly of the parts the resilient material portion of sealing member 7 which lies above the termination of sleeve 8 is under a distorting compression, resulting in a snug fitting assembly even though only ordinary shop tolerances are observed in the manufacture of the various parts. Such liberal tolerances in the component parts are less feasible when the construction shown in Fig. II is utilized.

Fig. V is illustrative of a form of my piston sealing member wherein rubber or other rubber-like resilient material of two hardnesses are used; the relatively softer material 18 being placed on the inner face of sleeve 8, and being allowed to flow over the upper termination 19 of sleeve 8 as shown. This construction affords greater ease of distortion to facilitate processing of the snap ring in place, as well as serving to increase the effectiveness of the seal between sealing member 7 and body 1, especially where surface irregularities exist on either part.

As illustrated in the several drawings flanged base portion 9 of metal sleeve 8 is of greater diameter than web 3 of the piston body. When the sealing member 7 finally fails in service the pumped fluid will begin to bypass the piston at extremely high velocities. In conventional pistons this commonly results in costly damage to both the

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piston body and pump liner. When this occurs in my improved piston the material of flanged base portion 9 that overhangs web 3, being softer than either the piston body or pump liner, will be eroded by the fluid jet action, opening up such annular fluid passageway between the pump liner and web 3 as is required to lower the pressure to a point at which it is no longer dangerous to said parts. As this washing and jetting action takes place chamfer 10 of base portion 9 aids in minimizing flow turbulence in this critical area and provides further protection for web 3.

Conventional pistons rely on fitting web 3 closely to the pump liner face to minimize pinching of the resilient sealing member due to extrusion or cold flow into this annular space. During its useful life the piston body carries several sets of sealing members throughout their useful life. During the useful life of the conventional piston body the web portion is worn away from its initial close fit by contact with the pump liner. This results in increasingly inadequate support of the sealing member at the most critical point. In contrast, my piston construction completely voids this problem since each new sealing member assembly provides its own new support and metal contact piece, affording that service with each new set of rubber parts which the conventional piston can only obtain by installation of a new piston body with each set of sealing members. In Fig. II a modification of flanged base 9a is shown in which a portion of this base along its outer periphery is extended upwardly parallel to and in the same direction as sleeve portion 8. This configuration functions to enlarge the bearing area of flange 9 to the liner face, and has a further function of providing a retaining shelf to minimize damaging displacements outwardly of the resilient material of sealing member 7 due to distortion caused by the pressure under which the piston is working. This feature is optional, its use being indicated advisable when a higher range of pressures are anticipated.

Piston body 1, as illustrated in Fig. IV, may have an annular groove 16 provided in web 3, which is for the acceptance of sealing ring 17. Sealing ring 17, in a preferred form, normally projects farther from the face of flange 9 than the depth of groove 16, which is sufficiently wider than sealing ring 17 to accommodate the distorted volume of the ring, resulting in a pressure-tight seal between web 3 and flange 9.

While I have herein implied that sleeve 8 is preferably formed of metal or a similar material it is the intention to cover the use of any material that is relatively rigid as compared to the resilient material of sealing member 7 and that provides a suitable bearing surface compatible to sliding contact with the material of which the cylinder liner may be formed and such materials are referred to in the appended claims inclusively with the term metal when used therein when identifying such part.

It is understood that it is the intention to cover all changes and modifications of the examples of the invention herein chosen for the purpose of illustration which do not constitute departures from the spirit and scope of the invention.

What I claim is:

1. As a new article of manufacture a piston seal member comprising a metal sleeve with a base flange and having an annular sealing member of resilient material bonded to the flange and to the outside of the sleeve, the end of the sealing member opposite said flange having an annular recess forming inner and outer annular concentric lips, and a sealing ring of resilient material bonded to the inside of the sleeve and concentric with said sealing member and terminating at the junction of the sleeve with the outer radial surface of the flange.

2. A piston comprising a cylindrical metal hub having a medially disposed radial web, a metal sleeve having a base flange of greater diameter than said web, a rubber sealing member bonded to the flange and to the outside of the sleeve, the end of the sealing member opposite said

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flange having an annular recess forming inner and outer annular concentric lips, a sealing ring of rubber bonded to the inside of the sleeve and terminating at the junction of the sleeve with the outer radial surface of the flange, and means for securing the sleeve operably on the hub.

3. In combination a piston comprising a cylindrical metal hub having a medially disposed radial web and having a section which is a frustrum of a cone the base portion of which terminates adjacent said web, and a piston seal member as in claim 1 being formed on its inner surface to be complementary in shape with said conical section of said metal hub.

4. For use on an annular piston hub having a medially disposed radial web, a piston seal member comprising a metal sleeve with a base flange, said flange being of greater diameter than said web and abutting the latter, and the outer periphery of said flange being chamfered outwardly beginning at the diameter of the web, an annular sealing member of resilient material bonded to the flange and to the outside of the sleeve, the end of the sealing member opposite said flange having an annular recess forming inner and outer annular concentric lips, and a sealing ring of resilient material bonded to the inside of the sleeve.

5. For use on an annular piston hub having a medially disposed radial web, a piston seal member comprising a metal sleeve with a base flange, said flange being of greater diameter than said web and abutting the latter, and the outer periphery of said flange being chamfered outwardly beginning at the diameter of the web, an annular sealing member of resilient material bonded to the flange and to the outside of the sleeve, and a sealing ring of resilient material bonded to the inside of the sleeve.

6. As a new article of manufacture a piston seal member comprising a metal sleeve having a base flange with a portion of said flange around its outer periphery extended parallel to and in the same direction as said sleeve, an annular sealing member of resilient material bonded to said flange and to the outside of said sleeve, a sealing ring of resilient material bonded to the inside of the sleeve and terminating at the junction of the sleeve with the other radial surface of the flange, and said sealing member being of substantially the same diameter as the outside diameter of said portion of the flange.

7. A piston comprising a cylindrical metal hub having a medially disposed radial web, a metal sleeve having a base flange of a greater diameter than said web, a rubber sealing member bonded to the flange and to the outside of the sleeve, the end of the sealing member opposite said flange having an annular recess forming inner and outer annular concentric lips, rubber bonded to the inside of said sleeve and extending beyond and around the end of the sleeve opposite the flange and joining said inner lip, said rubber terminating at the other end of the sleeve at the junction of the sleeve with the flange, and means for securing the sleeve operably on the hub.

8. In combination a piston comprising a cylindrical metal hub having a medially disposed radial web and having a section which is a frustrum of a cone the base portion of which terminates adjacent said web, and a piston seal member as in claim 6, being formed on its inner surface to conform to and seat upon said conical section of said metal hub.

9. As a new article of manufacture a piston seal member comprising a metal sleeve with a base flange and having an annular sealing member of resilient material bonded to the flange and to the outside of the sleeve, the end of the sealing member opposite said flange having an annular recess forming inner and outer annular concentric lips, resilient material bonded to the inside of said sleeve and said resilient materials being united beyond the end of the sleeve opposite said flange, said rubber terminating at the other end of the sleeve at the junction of the sleeve with the flange.

10. A piston comprising a cylindrical metal hub having a medially disposed radial web, a metal sleeve hav-

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ing a base flange, a rubber sealing member bonded to the outside of the sleeve and to the flange, the end of the sealing member opposite said flange having an annular recess forming inner and outer annular concentric lips, a rubber of softer composition bonded to the inside of said sleeve, said rubber member and said softer rubber being united beyond the end of the sleeve opposite the flange, and means for securing the sleeve operably on the hub.

11. In combination a piston comprising a cylindrical metal hub having a medially disposed radial web and having a section which is a frustrum of a cone the base portion of which terminates adjacent said web, a piston seal member as in claim 9, being formed on its inner surface to conform with and seal against said conical section of said metal hub.

12. As a new article of manufacture a piston seal member comprising a metal sleeve with a base flange, and having an annular sealing member of resilient material bonded to the flange and to the outside of the sleeve, the end of the sealing member opposite said flange having an annular recess forming inner and outer annular concentric lips, a resilient material of softer composition bonded to the inside of said sleeve and extending beyond and around the end of the sleeve opposite the flange and joining said inner lip.

13. A piston comprising a cylindrical metal hub having a medially disposed radial web, a metal sleeve having a base flange, a rubber sealing member bonded to the outside of the sleeve and to the flange, the end of the sealing member opposite said flange having an annular recess forming inner and outer annular concentric lips, rubber bonded to the inside of said sleeve and extending beyond and around the end of the sleeve opposite the flange and joining said inner lip, said rubber terminating at the other end of the sleeve at the junction of the sleeve with the flange, and means for securing the rubber sealing member and sleeve to the hub to provide compression of said second mentioned rubber.

14. In combination a piston comprising a cylindrical

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metal hub having a medially disposed radial web and having a section which is a frustrum of a cone the base portion of which terminates adjacent said web, a piston seal member as in claim 12 being formed on its inner surface to conform with and seal against said conical section of said metal hub.

15. As a new article of manufacture a piston seal member comprising a metal sleeve with a base flange and having an annular sealing member of rubber bonded to the flange and to the outside of the sleeve, the end of the sealing member opposite said flange having an annular recess forming inner and outer annular concentric lips, and a sealing ring of rubber of softer composition bonded to the inside of the sleeve.

16. In combination a piston comprising a cylindrical metal hub having a medially disposed radial web and having a section which is a frustrum of a cone the base portion of which terminates adjacent said web, a piston seal member as in claim 15 being formed on its inner surface to conform with and seal against said conical section of said metal hub.

17. As a new article of manufacture a piston seal member comprising a metal sleeve with a base flange and having an annular sealing member of rubber bonded to the flange and to the outside of the sleeve, the end of the sealing member opposite said flange having an annular recess forming inner and outer annular concentric lips, and a sealing ring of rubber bonded to the inside of the sleeve, said sealing ring of resilient material being formed with a conically tapering internal surface.

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