July 30, 1957 F. P. KRETZER 2,801,140

PISTON PACKING

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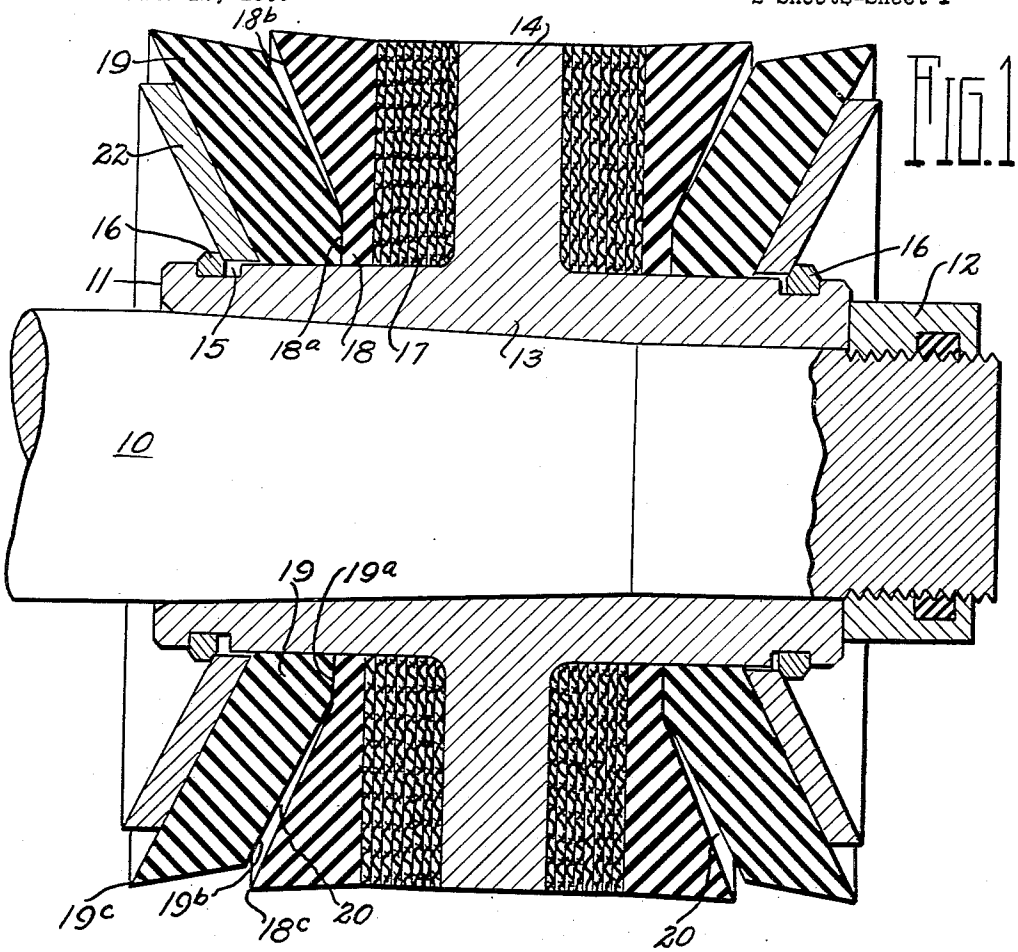

FIG. 1.

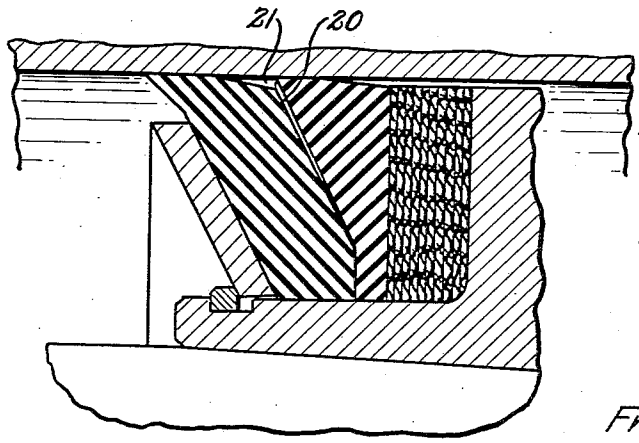

FIG. 2.

INVENTOR.
Fred P. Kretzer
BY
Owen & Owen
Attorneys

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FIG. 3.

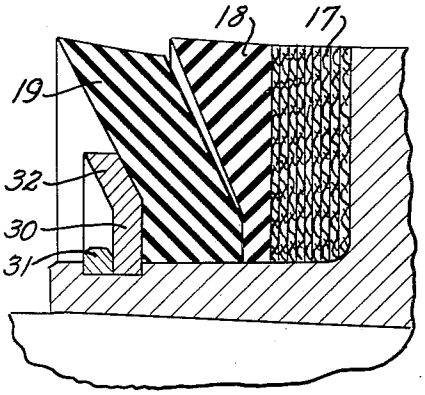


FIG. 4.

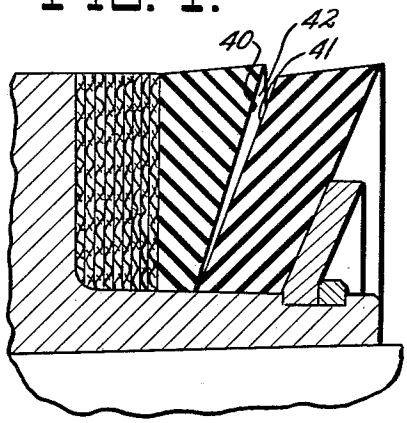


FIG. 5.

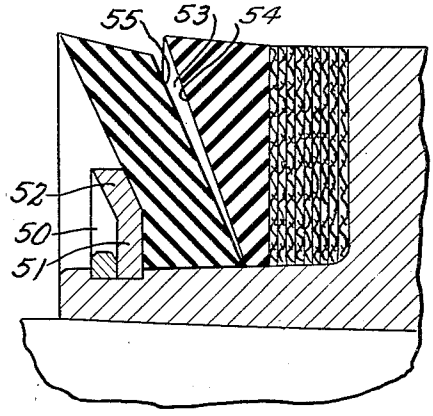
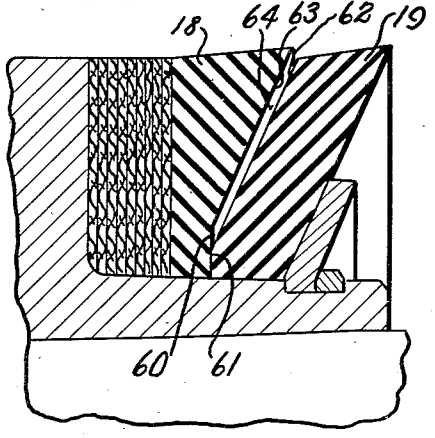


FIG. 6.



INVENTOR.
Fred P Kretzer
BY
Owen & Owen
Attorneys

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PISTON PACKING

Fred P. Kretzer, Gainesville, Tex., assignor to The National Supply Company, Pittsburgh, Pa., a corporation of Pennsylvania

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5 Claims. (Cl. 309—23)

This invention relates to packing members for pistons of the type used in pumps for the circulation of flushing fluid in oil well drilling apparatus. The primary object of the invention is to provide a piston packing having increased service life.

It has been known that packing members comprising flexible rubber elements, suitably backed to limit their movement during operation, give fairly satisfactory service in double acting pumps of the kind usually known as "slush pumps." These pumps are called upon to circulate either a water-base or oil-base mud or flushing fluid into a well being drilled, for the purpose of removing the cuttings from the vicinity of the drilling bit. The circulated mud may be quite viscous and may contain abrasive particles that cut and wear the pump packing. Obviously it is necessary to shut down the pump for the purpose of changing the packing rubbers and the expense of this operation should be avoided as long as possible. Packing constructed in accordance with the present invention has been found to have greatly increased life over known and competitive equipment.

An important object of the invention is the provision of a packing that will provide successive seals against leakage axially of the pump cylinder, sealing being obtained by spaced packing elements which are distorted by cooperation with the walls of the pump cylinder, being larger in diameter than the cylinder in which the pump piston operates.

Other objects and advantages of the invention will become apparent from the following specification, reference being had to the accompanying drawings, in which—

Fig. 1 is a central vertical sectional view of a pump piston packed in accordance with the present invention;

Fig 2 is a fragmentary sectional view of a piston packing inserted as it is formed when in a cylinder, the cylinder being shown only diagrammatically;

Fig. 3 is a fragmentary sectional view of a modified form of the invention;

Fig. 4 is a fragmentary sectional view of another modification in which juxtaposed packing ring surfaces are formed only incidentally to axial compression;

Fig. 5 is a fragmentary sectional view of another modification somewhat similar to the form shown in Fig. 4, and;

Fig. 6 is a fragmentary sectional view of another modification in which the divergent packing ring surfaces of the other forms of the invention have been replaced by spaced parallel surfaces.

Referring to the drawings, and particularly to Fig. 1, **10** designates a piston rod having the conventional tapered end over which a piston body **11** is received and retained by a suitable nut **12**. The body **11** comprises an axial hub **13** and an intermediate or central flange **14** which takes the axial load on the piston when the device is in use. Adjacent its ends the hub **13** is provided with annular grooves **15** for the reception of snap rings **16** which hold the several packing elements in assembled relation. Obviously any suitable retaining means could be used for this purpose.

Since the pump piston shown is intended to be double-acting so that pressure is developed by each end alternately, the packing elements are duplicated on each side of the center of the piston. Adjacent the central flange **14** is an annular disk **17** of impregnated fabric which is trimmed peripherally to have a running fit in the bore of the cylinder and which is shaped to lie closely around the hub **13** although it would not of itself provide a pressure tight seal on the interior surface adjacent the hub.

On the outer side of each of the fabric disks **17** is an inner rubber ring member **18**. The word "rubber" used herein includes compositions whose principal ingredient is a natural or synthetic elastomer mixed with suitable fillers, hardening agents, plasticizers and other compounding ingredients. The inner ring **18** has one of its radial surfaces mating with the fabric disk, while its opposite surface is formed first in a radial plane as at 18^a and then in the form of an intersecting cone 18^b. The periphery of the ring is flared outwardly either conically or in an arc of large radius from a small diameter coinciding substantially with the diameter of the fabric ring. The intersection of the peripheral surface and the conical surface 18^b forms a sharp lip 18^c.

A second or outer rubber ring member **19** is provided on each end of the piston. On its inner side each of the rings **19** is formed with a radial plane surface 19^a coinciding with and in close juxtaposition to the surface 18^a of the inner ring. Radially outward of the juxtaposed plane surface is a conical surface 19^b formed at a greater angle of divergence from the radial plane than its opposing surface 18^b so that a conical void **20** remains between the packing rings **18** and **19**. At its periphery the outer ring **19** is also conical from a base diameter again substantially equal to, but preferably less than, the diameter of the fabric disk **17** and extending outward to form a sharp lip 19^c. If the flared periphery of the outer ring is started from a base diameter less than the diameter of the cylinder in which the piston operates, a small void **21** will remain behind this ring and in front of the inner ring during operation.

Both rings **18** and **19** are thus larger in diameter than the working cylinder in which the pump piston operates so that they are distorted by insertion in the cylinder.

In the form of the invention so far described, a conically dished backing plate **22** bears against the outer surface of the outer ring **19** but terminates short of the periphery thereof so that the ring is free to flex during reciprocation of the piston. As above noted the several rings and plate are held against axial displacement by a snap ring **16**.

Fig. 2 shows the piston in its cylinder and indicates the normal displacement of the periphery of the packing rings **18** and **19** by insertion in the cylinder. It will be noted that the elastomeric material of the inner ring **18** has been forced into the void **20**, substantially filling the same. The volume of the void **20** is made substantially equal to or slightly greater than the volume of the material in the flared peripheral portion of the ring **18**.

The outer ring **19** is distorted also in the direction of the axis of the piston, but in the preferred form, the small void **21** remains open behind this ring. It is accepted practice that a piston of the type with which the present invention is concerned should be coated with a lubricant prior to installation in the cylinder to prevent burning and galling of the rubber rings during the initial strokes of the pump. Void **21** provides a reservoir for this initial lubrication, the lubricant being forced out as the piston moves back and forth in the cylinder, allowing the piston lips to move easily across the surface of the cylinder until the cylinder is filled with the fluid being pumped. Thus,

void 21, acting as a reservoir, provides for a more positive lubrication of the piston lips during this critical time.

During operation of the pump, lip 19c will wipe fluid from the cylinder wall which will collect in void 21. If, due to operating conditions such as poor suction, the liner wall is dry during part of the stroke, then the fluid collected in void 21 will provide a film of lubrication which will protect the piston lips.

In the preferred form of the invention the outer ring 19 would be made of a somewhat softer material than the inner ring 18. The outer ring 19 wears somewhat faster than the inner ring 18, but due to the construction of the piston and the functions of the outer ring, this wear is not detrimental. The outer ring 19 has two functions, depending upon the operating conditions and the degree to which the lip is worn. After an initial period of use the outer ring acts primarily as a wiper ring, protecting the sealing lip of the inner ring 18 from the damaging effects of sand grains and grit entrained in the fluid being pumped. Initially the outer ring acts as a sealing member in conjunction with the inner sealing ring 18, but as the lip 19c wears in service it may pass a limited quantity of fluid and thereafter acts as a wiper ring.

In sealing between a piston and cylinder of this type, two factors must be considered. The sealing material must be flexible enough to provide a tight seal to resist abrasion and yet firm enough to resist extrusion. Heretofore, pistons have had to sacrifice one for the other. In the piston of the present invention, the inner sealing ring 18 is firm enough to resist extrusion, but would abrade easily. The outer sealing ring 19 is made flexible enough to seal and resist abrasion, but would extrude easily. In conjunction with each other, the outer ring seals and protects the inner ring from abrasion, while the inner ring closes the clearance to protect the outer ring from extrusion.

The form of the retainer or backing plate 22 may be varied depending on the forces working against it. In some instances it may be desirable to replace the conically dished plate shown in Figs. 1 and 2 with a plate of the form shown in Fig. 3. As there shown the plate comprises a radial portion 30 against which a snap ring 31 is disposed, and a conical portion 32 extending from the radial portion. The front surface of the outer sealing ring 19 is molded to conform to the shape of the retainer plate.

In the form of the invention shown in Fig. 4, the radial plane surfaces 18a and 19a have been substantially eliminated by molding the adjacent surfaces of the sealing rings 18 and 19 as plane conical surfaces 40 and 41 with slightly different angles of divergence. A conical void 42 is thus established between the sealing rings, with the juxtaposed or meeting surfaces of the rings being limited to a small area near the hub which is established by squeezing the rings together during installation. Obviously it is not possible to maintain a complete separation of the sealing rings from the periphery to the hub without having the parts loose on the hub.

Fig. 5 shows a modification which includes the variations of Figs. 3 and 4. It will be seen that a retainer plate 50 shaped with a radial portion 51 and a conical portion 52 is provided. The void 53 between the sealing rings is a deep conical space formed by adjacent conical surfaces 54 and 55 of the sealing rings, with the juxtaposed surfaces of the sealing rings being formed by forcing the rings together during assembly and during insertion of the piston in its working cylinder.

In the forms so far described the void between the sealing rings has been formed by diverging surfaces. Fig. 6 shows a modification of the invention in which the facing surfaces of the sealing rings are not divergent, but parallel, at least in the relaxed state. In that modification the rings 18 and 19 are provided with radial juxtaposed surfaces 60 and 61 of differing radial extent. Parallel conical surfaces 62 and 63 extend to the periphery of the rings from the respective radial surfaces to form a void 64 which is of uniform width from top to bottom when the rings are relaxed. This void is, of course, partially filled by rubber displaced from the inner ring 18 when the piston is inserted in its cylinder, but is of sufficient extent to act as a reservoir for lubricant, while the juxtaposed surfaces 60 and 61 prevent flow of fluid along the hub.

While the invention has been disclosed in conjunction with certain specific modifications, it should be expressly understood that it is capable of numerous other modifications and changes within the scope of the appended claims.

What I claim is:

1. In a pump piston for pumping viscous abrasive bearing liquids the combination of, a piston body having a radial load carrying flange, and packing material on each side of said flange comprising, an inner deformable ring member larger in diameter than the working cylinder in which the piston operates, an outer deformable ring member also larger in diameter than the working cylinder in which the piston operates, said inner and outer ring members having juxtaposed surfaces and having diverging surfaces extending radially away from said juxtaposed surfaces to form a void between said members, the volume of said void being at least equal to the volume of material displaced in said inner ring member by insertion of the piston in the working cylinder, and a retaining member bearing against the outer face of said outer ring member.

2. In a pump piston for pumping viscous abrasive bearing liquids the combination of, a piston body having a radial load carrying flange, and packing material on each side of said flange comprising, an inner deformable ring member having a peripheral surface that is conical with respect to the axis of the piston and having its minimum diameter substantially equal to the diameter of the working cylinder in which the piston operates, an outer deformable ring member having a lip portion larger in diameter than the working cylinder in which the piston operates, said inner and outer ring members having juxtaposed surfaces and having surfaces extending radially away from said juxtaposed surfaces to form a void between said members, the volume of said void being at least equal to the volume of material displaced in said inner ring member by insertion of the piston in the working cylinder, and a retaining member bearing against the outer face of said outer ring member.

3. In a pump piston for pumping viscous abrasive bearing liquids the combination of, a piston body having a radial load carrying flange, and packing material on each side of said flange comprising, an inner deformable ring member having a peripheral surface that is conical with respect to the axis of the piston and having its minimum diameter substantially equal to the diameter of the working cylinder in which the piston operates, an outer deformable ring member having a lip portion larger in diameter than the working cylinder in which the piston operates, said inner and outer ring members having justaposed surfaces and having diverging surfaces extending radially away from said juxtaposed surfaces to form a void between said members, the volume of said void being at least equal to the volume of material displaced in said inner ring member by insertion of the piston in the working cylinder, and a retaining member bearing against the outer face of said outer ring member.

4. In a pump piston for pumping viscous abrasive bearing liquids the combination of, a piston body having a radial load carrying flange, and packing material on each side of said flange comprising an inner deformable ring member having a peripheral surface that is conical with respect to the axis of the piston and having its minimum diameter substantially equal to the diameter of the working cylinder in which the piston operates, an outer deformable ring member larger in diameter than the cylinder in which the piston operates and hav-

ing its largest diameter terminating in a sharp wiping lip, said inner and outer ring members having juxtaposed surfaces and having diverging surfaces extending radially away from said juxtaposed surfaces to form a void between said members, the volume of said void being at least equal to the volume of material displaced in said inner ring member by insertion of the piston in the working cylinder, and a retaining member bearing against the outer face of said outer ring member.

5. In a pump piston for pumping viscous abrasive bearing liquids the combination of, a piston body having a radial load carrying flange, and packing material on each side of said flange comprising an inner deformable ring member having a peripheral surface that is conical with respect to the axis of the piston and having its minimum diameter substantially equal to the diameter of the working cylinder in which the piston operates, an outer deformable ring member having a conical peripheral surface the maximum diameter of which is larger than the diameter of the cylinder in which the piston operates to form a lubricant reservoir behind

said maximum diameter, said inner and outer ring members having juxtaposed surfaces and having diverging surfaces extending radially away from said juxtaposed surfaces to form a void between said members, the volume of said void being at least equal to the volume of material displaced in said inner ring member by insertion of the piston in the working cylinder, and a retaining member bearing against the outer face of said outer ring member.

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