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WIPER FOR OIL WELL SUCKER RODS AND THE LIKE

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3 Sheets-Sheet 2

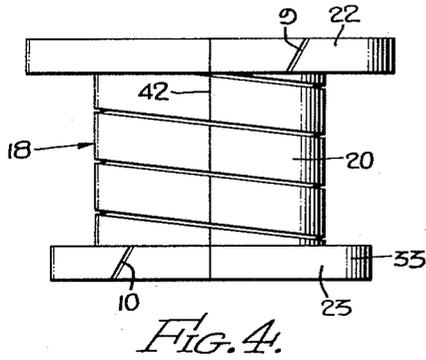


FIG. 4.

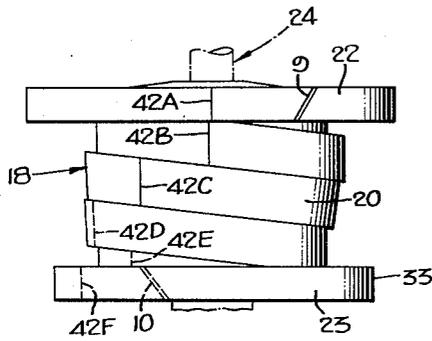


FIG. 5.

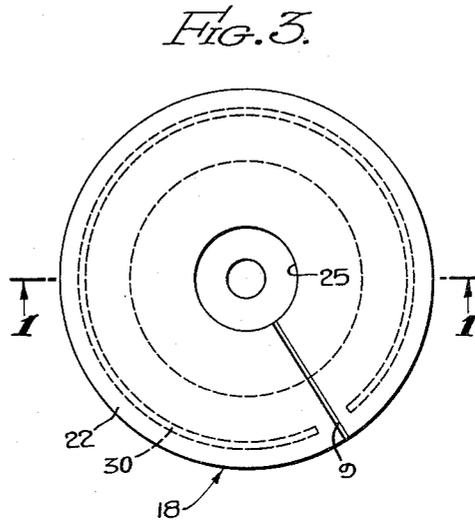
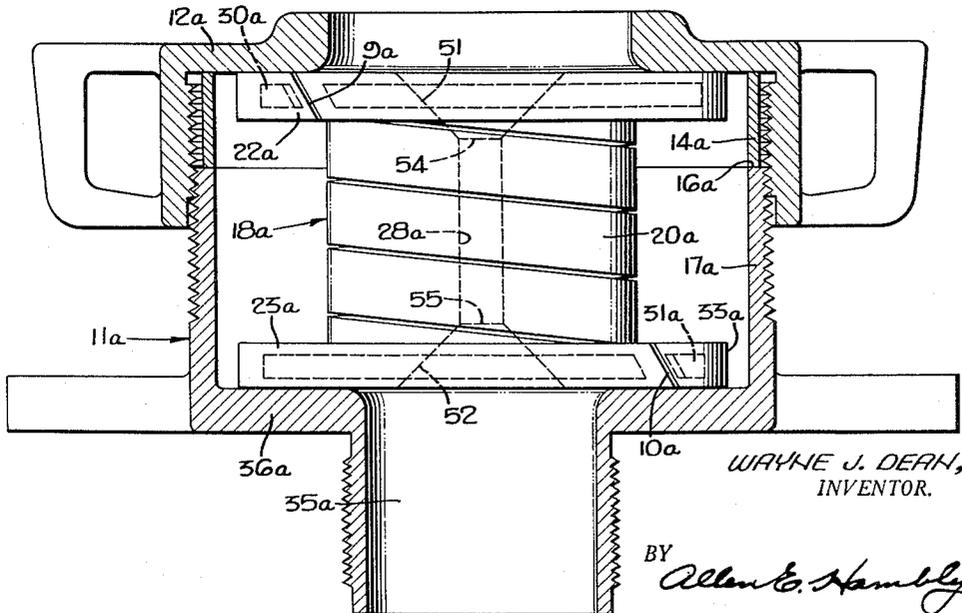


FIG. 6.



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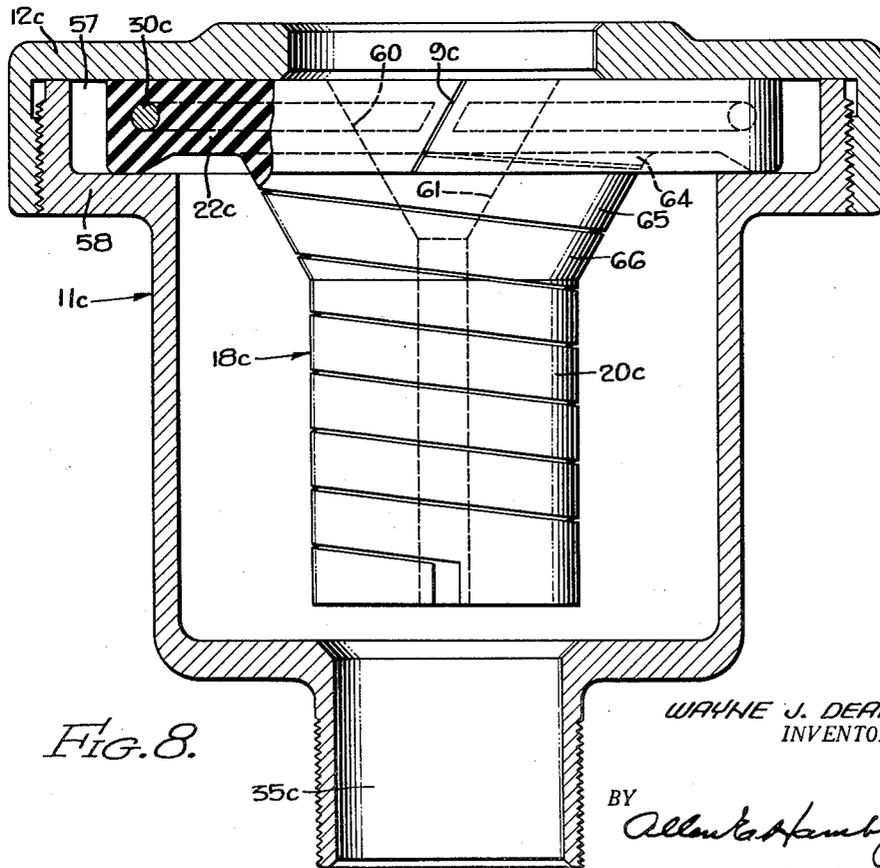
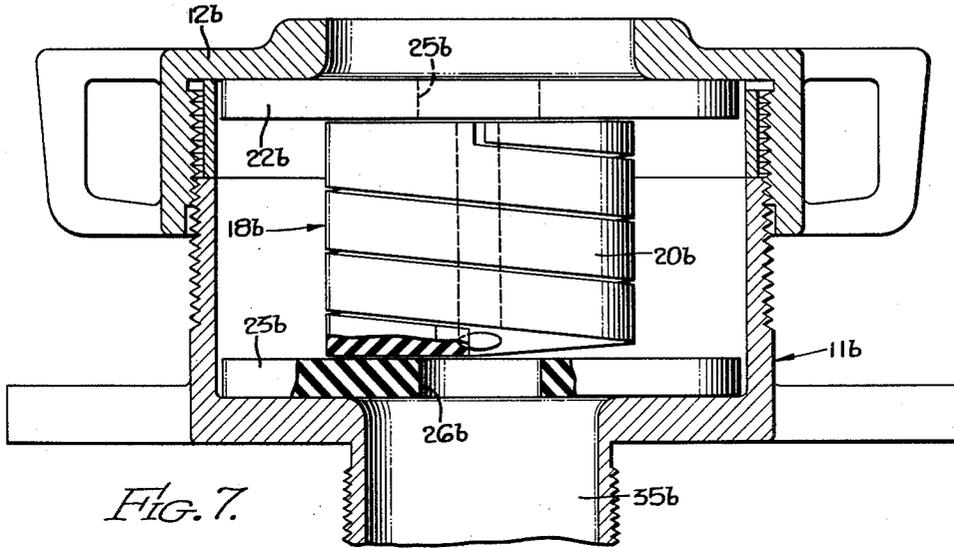
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Application February 28, 1955, Serial No. 490,740

15 Claims. (Cl. 15—210)

The present invention is adapted to clean liquid coated rods, small diameter tubing, or other generally cylindrical members. It is particularly useful in oil field operations, as for example in connection with wiping of sucker rods of oil well pumps.

The usual oil well pump is operated by a sectional sucker rod extending from the ground surface to the pump located at the lower end of the well tubing. Occasionally it becomes necessary to withdraw the sucker rod from the well in order to service the pump. Since the rod is coated with oil, it is desirable to provide a wiping action to dry it as it is withdrawn from the well. This prevents the men handling the rod from being sprayed with oil, and also avoids formation of hazardous oil slicks from the drippings.

In the past, sucker rod wipers have usually been disc-shaped, with a central opening through which the rod was passed. In some cases tandem arrangements have been used wherein the rod was passed through two discs. The wiping action was brought about as a result of the central opening in the wiper discs being normally of smaller diameter than the outer diameter of the rod, so that the rubber squeezed down upon the rod.

The intrinsic disadvantage of disc wipers is that the central opening must be small enough to constrict about the intermediate portion of the rod, but yet must expand excessively to pass the enlarged end portions. The end portions of each length of rod are squared so that a wrench can be applied to make or break the union between the rod and a coupling sleeve. To avoid the possibility of the wrench slipping off the tool square, raised annular portions are formed on both sides of the square. When these raised portions and the coupling sleeve pass through the discs wipers, they cause a great increase in hoop stress. This tears the rubber and thereby unduly diminishes the effective life of the wiper.

The present invention provides a unique solution to the problem of designing a wiper which will both squeeze down upon the intermediate rod portions and expand without permanent deformation to pass the enlarged end portions and the coupling sleeves. The generic concept involves the use of a helical body of elastic material through which the rod passes. The inner diameter of the helical body is small enough to grip the rod for an effective wiping action. As the end portions of the rod, and the couplings pass through the body, a unique adjustment occurs. The coils of the helix unwind and then return to their original setting. A very effective wiping action takes place as the coils adjust to the changing diameter of the rod and rod couplings, but yet the wiper element does not take a permanent set from the unwinding.

The ease with which this unwinding and rewinding action takes place is attributable to the fact that the leading end of the wiping element—i. e., the end through which the sucker rod or other member enters the wiping passage—is free to rotate about the axis of the helix and is also free to move axially in the direction of movement of the rod being wiped. This freedom of movement per-

mits the successive coils of the helix to adapt their inner diameter to the diameter of any enlargement as it passes through the wiper, but without requiring any increase in the helical length of the wiper element. The only deformation of the material of the wiper element is a decrease in curvature to accommodate it to the diameter of the enlargement.

Because of its unwinding action, the wiper will accommodate rods of various standard sizes. This universal feature is advantageous because it eliminates multiple size stocking problems, and it also enables the pump operator in the field to use one wiper for all of the standard rods or macaroni tubing in use. It has been found that a helical wiper according to this invention having an internal diameter of about $\frac{7}{16}$ " will accommodate all the standard API rods which are between $\frac{5}{8}$ " and $1\frac{1}{8}$ " in normal diameter. Furthermore, the expansion of the coils by unwinding of the helix results in the exertion of only very slightly greater pressure and frictional drag on the enlarged portions than on the normal diameter portions of the member being wiped. Consequently the frictional wear on the wiper element is greatly reduced, resulting in a greatly prolonged service life as compared with that of wipers heretofore in use.

Since the wiper coils are under practically no tensile stress there is no tear resistance problem, as there is with disc type wipers. In these later types the wiper is placed under great stress when the diameter of the member being pulled through it increases. Since the tear resistance diminishes rapidly when rubber or a similar material is under high tensile stress, a sharp edge or a sudden pressure by the member being wiped may cause a disc wiper to tear. Because tensile stresses are very low in the helical wiper of this invention, it has high tear resistance and correspondingly long life.

Another advantageous feature of the instant invention, particularly when applied to wiping oil well sucker rods, is the effective manner in which the wiping element functions as a fluid seal. Frequently when pulling a string of sucker rods from a well, intermittent slugs of gas and/or oil may reach the surface through the well tubing. This is referred to as "heading." The well head equipment includes a flow line to a storage tank, but the capacity of this line is often not sufficient to carry off these "heads" of gas and/or oil, resulting in a temporary build-up of pressure in the wiper housing, which is attached to the tubing head. This pressure may be temporarily on the order of 50 to 100 p. s. i. or even higher.

The sucker rod wipers heretofore in common use are not capable of effecting a seal against upward flow of gas and oil during such "heading" periods. On the other hand, when a wiper embodying the instant invention is subjected to pressure of the order mentioned above, the pressure acts against the outer peripheral surface of the helical coils to force them radially inwardly into sealing engagement with the sucker rod, thus preventing leaking upwardly between the rod and the wiper. In those embodiments of the wiper which have lower backing discs, the pressure acts upwardly against the disc to force the wiper in an upward direction. At the same time pressure acts against the bottom annular surface of an upper backing disc so that a tight seal is effected between the upper disc and the lid of the wiper housing. Leakage between the wiper and the housing is thus prevented.

Some leakage might occur if a coupling were being pulled through the wiper, as indicated in Figure 2, while the well is heading. However, it is customary to discontinue the hoisting operation temporarily during such heading periods, with the wiper engaging a constant diameter intermediate portion of one of the rod sections. Under those circumstances the instant wiper has successfully sealed off against a pressure of at least 100 p. s. i.

The use of helical wiper elements to perform a wiping action is not per se new. It will be noted that in the wire line wiper patents to Miller 2,239,159; Miller 2,285,742 and Miller 2,657,414 helical wiper elements are utilized. However, those wiper elements are either confined against radial expansion or their ends are anchored against relative rotation when in use, so that no unwinding action takes place. In fact unwinding would not be desirable because the line being wiped is of constant diameter, and an unwinding action would preclude effective wiping. It is apparent that this prior art does not contemplate or solve the problem that the instant invention is concerned with.

In a preferred form of the invention, as herein illustrated the wiper is carried within a conventional type housing. An intermediate helical wiping portion is bonded between upper and lower annular backing discs which prevent pulling of the spiral out through the centrally apertured lid or body of the wiper housing. The backing discs have central openings whose diameters are both the same, and which are larger than the internal diameter of the helical portion. This relieves the discs of unnecessary stress and prevents their deformation as the enlargements on the sucker rods are pulled through them. Although both discs could be made to have identical outer diameters, thereby making the wiper invertible, the preferred embodiment is one in which the lower disc is of a smaller outer diameter than is the upper disc. This is done so that the heavier paraffins wiped by the helical portion can more easily flow out through the bottom of the housing. Both the upper and lower discs are cut radially so that, if desired, the wiper can be cork-screwed onto a string of rods without first uncoupling them. In addition, a split ring is molded within each disc to stiffen them.

In a second species disclosed, the upper and lower discs are identical, so that the wiper is invertible within its housing. In addition, the central opening in each disc flares outwardly. This provides another way of relieving the discs of unnecessary hoop stress.

The third species disclosed is similar to the first species in that the relieving of hoop stress in the discs is accomplished by making the central openings therein larger than the internal diameter of the spiral. In this species, the helical wiping element is not bonded to either of the backing discs, so that it may unwind independently of them, and can be inverted as desired.

In a fourth species, there is illustrated a wiper bonded to and having only an upper backing disc. This disc is clamped within a recess in a special housing. When a sucker rod is pulled up through the wiper, the disc will prevent pulling of the helix out through the lid of the housing, and if the sucker rod is pulled down through the wiper, the helix cannot be squeezed down through the bottom of the housing because it is held by the disc. A flare is designed into the upper coils of the helix and into the backing disc. The disc is cut radially and contains an internal split ring stiffener.

It is an object of the invention to provide a wiper having a helical wiping element and a backing disc against which the helix is pressed as it unwinds and wipes a cylindrical member of varying diameter which is pulled through the wiper.

It is a further object of the invention to provide a wiper having a helical wiping element and a backing disc against which the helix is pressed as it unwinds and wipes, the disc having a central opening of greater diameter than the internal diameter of the spiral element.

Further objects of the invention will appear hereinafter.

Referring now to the drawings, Figure 1 is a view, partly in elevation and partly in section along line 1—1 of Figure 3, of a preferred form of the invention.

Figure 2 illustrates a longitudinal sectional view of the preferred embodiment, showing the wiper in the position

assumed as an enlargement on a sucker rod is being drawn through the wiper.

Figure 3 is a top plan view of the preferred embodiment showing the radially cut upper pressure disc.

Figures 4 and 5 are views in side elevation illustrating the unwinding action of the helical wiper element. Figure 4 shows the helix before wiping action, and Figure 5 depicts the coils of the helix after the rod has been pulled part way through the wiper.

Figure 6 is an elevation view of a second species of the invention.

Figure 7 is an elevation view, partly in section, of a third species of the invention.

Figure 8 is an elevation view, partly in section, of a fourth species of the invention.

In the preferred form of the invention illustrated in Figures 1 to 5, the wiper housing comprises a body 11 and a lid member 12 threadably secured thereto. An annular spacer ring 14 rests on the top face 16 of the body. This spacer ring determines the extent to which the lid 12 can be screwed down onto the body. It should be understood that the body 12 could be designed so that wall 17 would be longer and the spacer ring 14 thereby eliminated. All that is important is that the wiper assembly 18 is not squeezed down too tightly by the lid 12, since this would hamper the unique unwinding action described below. Preferably some clearance exists between the lid and the top of the wiper when it is in the relaxed position of Figure 1.

The wiper 18 consists of a helical portion 20 bonded at the top and bottom to annular backing discs 22 and 23 respectively. The backing discs are provided so as to prevent the wiper from being pulled out through the lid or the body as the sucker rod is moved therethrough. The coils of the helical portion 20 have identical internal diameters in the unstressed position of Figure 1; whereas in the position of Figure 2, with sucker rod 24 being pulled through the wiper, the internal diameters of the coils vary according to the changing outer diameter of the sucker rod.

In order to avoid unnecessary deformation of the annular backing discs 22 and 23, their inner diameters, as at 25 and 26, are larger than the inner diameter, as at 28, of spiral 20. The diameters 25 and 26 are large enough to pass easily a coupling sleeve 29 and any sucker rod 24 of standard size between $\frac{5}{8}$ " and $1\frac{1}{8}$ " O. D. Rods in this size range are mentioned only by way of illustration since obviously the dimensions of the wiper can be changed according to the size of the objects being wiped.

The backing discs 22 and 23 are both split radially with a bias cut as at 9 and 10 respectively (see Figures 3 and 4) so that the wiper can be cork-screwed onto the sucker rod without having to first uncouple the rod string. The splits are bias cut so that if the discs open up after usage the ends of the split will still maintain some contact and give the discs desired rigidity. Split rings 30 and 31 are bonded within discs 22 and 23 respectively in order to make them more rigid. The plan view of Figure 3 illustrates the split 9 and the stiffener ring 30 in disc 22.

The bottom disc 23 is preferably of lesser outer diameter than the upper disc 22. More space is thereby provided between the outer periphery 33 of disc 23 and the wall 17. Because of this additional space the heavier paraffins wiped from the rod 24 can more easily flow out through passage 35. It will be appreciated that even with the smaller outer diameter, the disc 23 is stiff enough to prevent the wiper from being pulled through passage 35 in the event that the sucker rod moves downward instead of upward in the normal fashion.

As seen in Figure 2, sucker rod 24 has an intermediate portion 37 of constant diameter. Both ends of the rod are male ends and have tool squares 38 formed between raised portions 39 and 40. Successive lengths of rod are coupled through sleeves 29. When the end of a rod

and a coupling sleeve are pulled through the wiper, the helical coils 20 provide an especially effective wiping action because they unwind and change in internal diameter to accommodate the changing diameter of the rod and coupling sleeve.

Figures 4 and 5 illustrate the unwinding which accompanies the wiping action. An imaginary line 42 in Figure 4 has been drawn longitudinally down the wiper as an indication of the condition when the wiper is unstressed. When the rod 24 is pulled through the wiper, the upper backing disc 22 is forced against the lid 12, as in Figure 2. As the rod moves upwardly through the wiper to a point where the tool square is within the wiper, the disc 22 remains in the same position as in Figure 4, but the helical portion 20 unwinds and the lower disc 23 rotates. The line 42 of Figure 4 adjusts into the segments 42A, 42B, 42C, 42D, 42E, and 42F. As the rod end and coupling sleeve are moved up out of the wiper the coils wind back so that their internal diameters are just large enough to make wiping contact with the intermediate portion of the rod. It is seen that because of the radially undulating action of the wiper, a continuous, efficient wiping action occurs at all times. In addition, since the coils of the wiper are not stressed unduly, the wiper has an exceptionally long life.

The species of Figure 6 is similar to that of Figures 1 to 5, and therefore is not described completely. Like parts have been given the same number, but with subscripts added.

It will be seen that the wiper assembly 18a is carried between body 11a and lid 12a of a housing in the same fashion as wiper assembly 18 in the first species illustrated. The wiper of Figure 6 is invertible since backing discs 22a and 23a have the same dimensions. Both discs have bias-cut radial splits 9a and 10a respectively, and contain split ring stiffeners 30a and 31a.

In order to relieve the backing discs of undue hoop stress, they are flared at 51 and 52 respectively. The flares start within the helical portion 20a, as at 54 and 55, in order to provide a smooth transition out from and into the passage 28a.

The species of Figure 7 includes a helical portion 20b which is not affixed to either of the backing discs 22b and 23b. The helix is therefore free to unwind independently of either disc. Although the discs are illustrated as not having radial splits or split ring stiffeners, it will be appreciated that they could be so modified.

The wiper assembly 18c of Figure 8 is carried within a special housing. The housing body 11c is shaped so that an annular pocket 57 is formed between annular lip 58 of the body wall and lid 12c. It will be appreciated that this is done so that the periphery of backing disc 22c can be tightly secured within the pocket. The disc will prevent pulling of the helical portion 20c out through the centrally apertured lid 12c, and it will also prevent its being pulled down through the outflow passage 35c if the rod being wiped should move downwardly.

The backing disc 22c is radially split on the bias at 9c and contains the split ring stiffener 30c bonded within it. The disc is internally flared at 60. This flare is a continuation of the internal flare 61 of the top coils 64, 65, and 66 of spiral 20c. These top coils are strengthened by externally flaring them to provide increased cross-sectional area.

It will be apparent from the foregoing description of a preferred embodiment and several modified forms that the instant invention provides a wiper which, because of the unique manner in which it adjusts itself to accommodate members of varying diameters possesses a number of outstanding and superior characteristics. Inasmuch as the increase in inner diameter of the coils is effected by an unwinding action, as distinguished from purely radial expansion thereof, the extent of distortion and displacement of the elastic material for a given in-

crease in inner diameter is negligible as compared to other types of wipers.

As a consequence, the wiping pressure exerted on enlargements passing through the wiper is not materially greater than that exerted on portions of smaller, normal diameter. This obviously results in a substantial reduction in wear and a corresponding increase in the effective service life of the wiping element. Furthermore, inasmuch as the tear resistance of rubber and rubber-like compounds is greatly reduced under high tensile stress, a wiping element embodying the instant invention is more resistant than other types to being torn or otherwise damaged by abrupt shoulders or sharp edges on the member being wiped.

These properties of increased wear and tear resistance have been proven by actual field tests of wipers embodying the instant invention. For example, in installations where other types and designs of sucker rod wipers required replacement of the wiping element after wiping two 3000 foot strings of sucker rods, wiping elements embodying this invention have still been in good condition after ten such runs.

Another outstanding advantage of the instant invention resides in the universal adaptability of the wiping element to different diameters, made possible by the unique unwinding action of the helical coils. This characteristic becomes especially important and valuable at oil well pumping installations wherein sections of the string of sucker rods are of different sizes—usually referred to as "mixed strings." Heretofore it has been necessary in such cases to interrupt the rod-pulling operation to change to a different size of wiping element whenever a section of different sized rods reaches the wiper. This is not necessary with a wiping element according to this invention, thus saving valuable time and avoiding the necessity of providing several different sizes of wipers on each such pulling job.

The unprecedented wide range of adjustability of the instant wiper is forcibly illustrated by the fact that it is not only capable of adapting itself to different sized rods and to the rod couplings, but it will also accommodate elements connected in the string of rods which are many times the diameter of the rods, such as the pump plunger or working barrel, certain types of paraffin-scrappers, and the like. For example, a string of $\frac{5}{8}$ " rods may have a 3" diameter pump plunger connected to its lower end. Heretofore it has been necessary to take precautions against pulling such elements into other types of wipers, such as keeping an accurate count of the number of rod sections pulled and slowing down the hoisting speed as the large diameter element approaches the wiper. With the instant wiper such precautions are unnecessary.

As pointed out hereinabove, a wiper embodying the instant invention possesses the additional advantage of providing an effective fluid seal. This advantage assumes particular importance when the wiper is applied to wiping oil well sucker rods, as it prevents escape from the well head of oil and gas in the event the well should "head" during the rod-pulling operation.

Although the invention has been illustrated and described in connection with a particular application thereof—i. e., as a sucker rod wiper—it will be apparent that it has a wide field of application, wherever it is desired to wipe an elongated member of generally circular cross-section, and particularly with two or more portions of different size or diameter.

It will be appreciated that various modifications of the four species disclosed will suggest themselves to one skilled in the art. Changes may be made which will be within the true scope of the invention as defined in the following claims.

What is claimed is:

1. A wiper for use in a housing having a lid with an opening for the passage therethrough of an element

to be wiped comprising a helix of elastic material having a central longitudinal straight passage therethrough for passage of a member to be wiped, said passage having a leading end and an exit end, a radial flange on said helix adjacent the exit end of the passage, the leading end of said helix being free to unwind and rewind as an enlargement on said member is moved through the passage.

2. A wiper as in claim 1 wherein a split stiffener ring is molded within the radial flange.

3. A wiper as in claim 1 wherein the radial flange is cut radially.

4. A wiper as in claim 1 wherein a second radial flange is disposed adjacent the leading end of the passage for engagement with the housing with the exit end of said helix free to wind and unwind as an enlargement on said member is moved through the passage.

5. A wiper as in claim 1 wherein the annular radial flange is formed with a central opening which is flared in a direction away from the passage through the helix.

6. In a wiper assembly, the combination of a housing and an attached lid member, the housing and lid having central openings in axial alignment to permit the passage therethrough of an element to be wiped, and a helix of elastic material mounted in the housing, the helix being formed of a plurality of coils which define a central wiping passage in alignment with said central openings, said passage having a leading end and an exit end, a backing annulus between one end of the helix and the lid restraining axial movement of the helix in the direction of the exit end of the passage, the leading end of the helix being free to expand and contract radially, and to unwind and rewind as an enlargement on a member being wiped is moved through the passage.

7. A wiper assembly as in claim 6 wherein said backing annulus is separate from the helix.

8. A wiper assembly as in claim 6 wherein a second annulus is carried between the other end of the helix and the housing.

9. A wiper assembly as in claim 6 wherein the housing is provided with an annular seat between the housing and the lid, the backing annulus being bonded to the top of the helix and having a peripheral portion thereof carried within said annular pocket.

10. A wiper assembly as defined in claim 6, wherein the housing includes means defining an annular seat, said backing annulus having its outer margin disposed between said seat and said lid.

11. In a wiper assembly, the combination of a hollow housing member having a lid member, the said members having aligned openings to permit the passage therethrough of an element to be wiped, a resilient wiper element disposed in said housing, said wiper element including a helical body spaced from said housing member and free to wind and unwind, said body having a central opening axially therethrough whereby an element to be wiped may extend through the openings in the housing member, the body and the lid member, and means interposed between one end of said body and one of said members to limit movement of said body with an element to be wiped so that the body will unwind as an enlargement on the element to be wiped passes through said body in a direction towards said means.

12. A wiper assembly as defined in claim 11, wherein the means for limiting movement of the body with the element to be wiped includes an annular member bridging the opening in said lid.

13. A wiper assembly as defined in claim 11, wherein the means for limiting movement of the body with the element to be wiped includes an annular member bridging the opening in said housing.

14. A wiper assembly as defined in claim 11, wherein the means for limiting movement of the body with the element to be wiped includes a radial flange integral with said body and bridging the opening in said lid.

15. A wiper assembly as defined in claim 11, wherein the means for limiting movement of the body with the element to be wiped includes a radial flange integral with said body and bridging the opening in said housing.

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