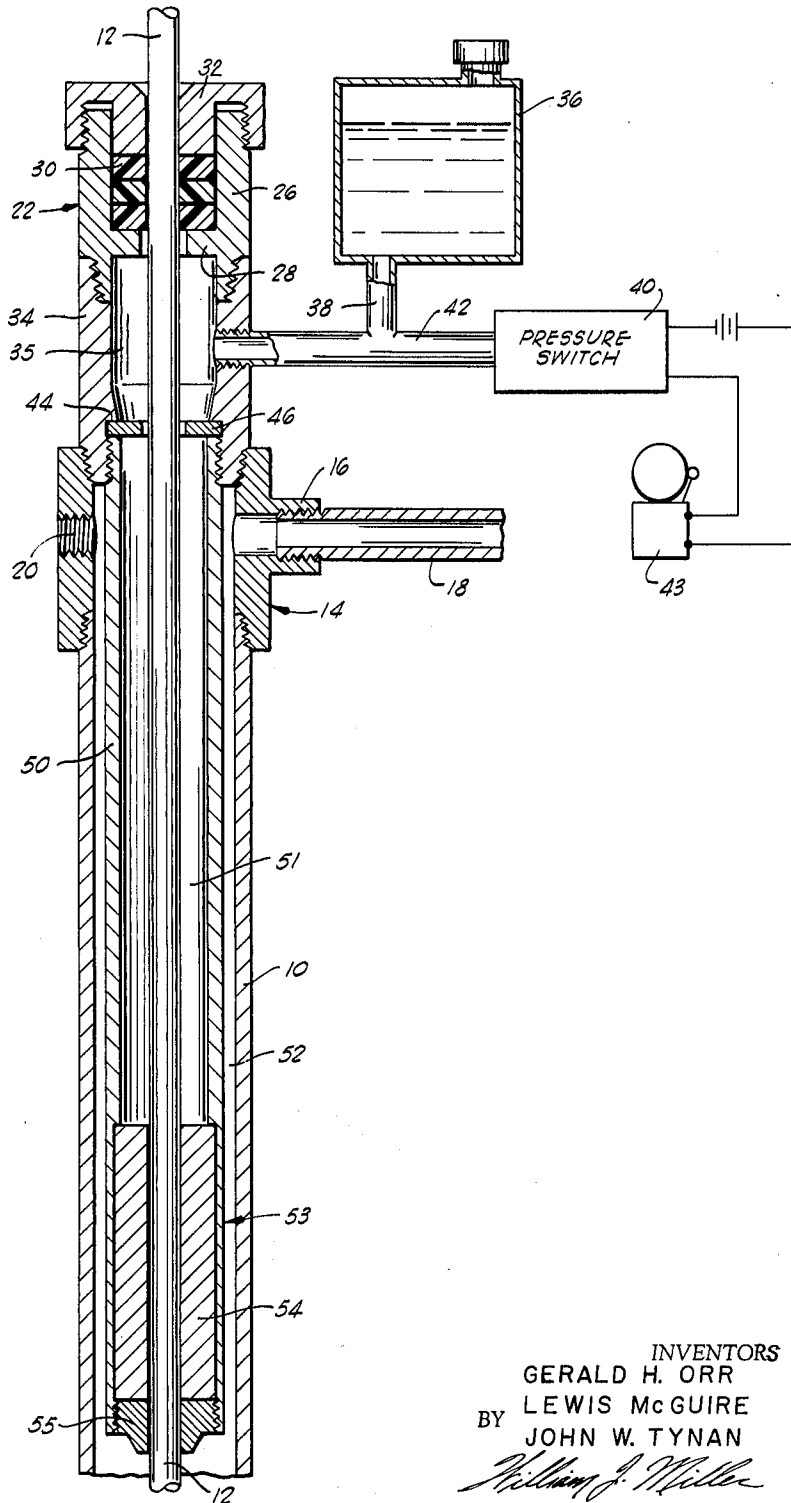


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STUFFING BOX ASSEMBLY

Filed March 29, 1963



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STUFFING BOX ASSEMBLY

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Filed Mar. 29, 1963, Ser. No. 268,865

12 Claims. (Cl. 166—84)

This invention relates to pumping equipment for producing petroleum from subterranean formations. More particularly, the invention relates to stuffing box assemblies used for capping the upper end of an oil well tubing string, and to seal around the polished rod of a string of sucker rods used in a reciprocating oil well pump.

Various types of stuffing boxes have heretofore been proposed and utilized in the petroleum industry for providing a tight seal around the polished rod at the upper end of a string of sucker rods used in a conventional sucker rod reciprocating pump for producing oil from underground formations. These stuffing boxes also function to cap or seal off the upper end of the tubing string of the oil well and are generally positioned above the pumping T which diverts the oil from the tubing string to a flow line for conveyance to storage facilities. It has been generally characteristic of stuffing boxes that these devices include a housing through which the polished rod of the sucker rod string passes, and further include some type of packing enclosed within the housing and around the polished rod. The stuffing box also conventionally includes a threaded sleeve around the housing which is formed integrally with a compression ring which extends down into the housing and bears against the packing therein. By adjusting, from time to time, the position of the threaded sleeve on the housing, the packing may be compressed to a greater degree to compensate for wear of the packing by the continuous reciprocation of the polished rod therethrough.

In some of the more recent innovations in stuffing box construction, it has been proposed to add a source of lubricating fluid to the stuffing box assembly so that lubricant may be constantly fed into the stuffing box to continuously lubricate the polished rod as it reciprocates through the stuffing box. The provision of lubricant in this manner, of course, reduces the frictional wear of the polished rod on the packing and also assists in maintaining the peripheral surface of the polished rod clean and free of deleterious materials.

Despite the improvement which is effected in the performance of stuffing boxes by the inclusion therein, or combination therewith, of a source of lubricant which provides continuous lubrication of the polished rod stuffing boxes have still been characterized in many cases by a foreshortened operating life as a result of burning out of the seals of the stuffing box, failure of the packing or other similar malfunction which permits leakage to develop through the stuffing box around the polished rod. Such failures are engendered by several conditions which may be present in greater or lesser degree in any pumping situation. Thus, in some wells, very high pressures are developed in the flow line of the well, as well as in the tubing string, and these pressures increase the wear to which the stuffing box seals around the polished rod are subjected. Also, if the conditions at the surface of the ground around the well are extremely dusty, the polished rod picks up a substantial amount of dust and dirt on its surface as it is pulled upwardly through the stuffing box and this dirt is then carried down through the packing of the stuffing box, wearing away the packing and destroying the seals of the stuffing box. This condition is aggravated where the fluid being pumped from the well is especially dirty or is saline or is highly corrosive.

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In such instances, not only are the deleterious fluids carried into the stuffing box through the seals thereof, but the corrosive materials in the well fluids may attack and pit the polished rod so that its roughened outer peripheral surface quickly destroys the stuffing box seals and packing or at least necessitates frequent adjustment of the packing compression. In almost all situations, the stuffing box will require daily maintenance and, in effect, continual adjustment of the compression on the packing therein in order to maintain a tight seal around the polished rod and avoid loss of production fluids through the stuffing box.

The present invention contemplates an improvement in stuffing box assemblies and, more specifically, proposes a novel stuffing box assembly which enables the integrity of the stuffing box seals and the performance of the stuffing box packing to be constantly and automatically monitored, and which assures a substantial increase in the average trouble-free service life of stuffing box assemblies. For the sake of clarity in explaining and describing the present invention, it may be stated at the outset that the stuffing box assembly of the invention is of the type which is adapted to be used in an oil well which includes a tubing string through which the oil is produced, a pumping T adjacent the top of the tubing string for diverting oil from the tubing string into an oil flow line leading to storage, a string of sucker rods extending downwardly into the tubing string for pumping the oil upwardly in the tubing string, a polished rod connected to the top of the string of sucker rods and extending through the pumping T, and a suitable pumping jack for reciprocating the sucker rod string, including the polished rod, in the tubing string.

The stuffing box assembly of the invention is incorporated in the described apparatus by connecting the stuffing box proper, or what may be called the stuffing box housing, to the pumping T and around the polished rod so that the upper end of the tubing string is capped by the stuffing box and the packing in the stuffing box forms a tight seal around the polished rod. In addition to the stuffing box housing, the packing inside the housing and suitable means for adjusting the compression of the packing in the housing, the stuffing box assembly of the present invention further includes an extension tube which extends downwardly through the pumping T and into the tubing string below the pumping T, with such extension tube having inside and outside diameters such that the extension tube defines a first annulus with the polished rod, and a second annulus with the tubing string into which it projects. The first annulus formed between the extension tube and the polished rod is filled with a clean lubricating fluid so that the portion of the polished rod which moves through a metal to metal seal formed between the extension tube and the polished rod at the lower end of the first annulus is continuously bathed in clean lubricating fluid during the operation of the pump. Preferably, the extension tube is of such length that the distance between the metal to metal seal which closes or seals the first annulus at its lower end and the packing of the stuffing box is at least equal to the length of stroke of the pump in use. In this way, assurance is provided that that portion of the polished rod which moves through the metal to metal seal at the lower end of the extension tube will always move upwardly through a path which lies entirely in the clean lubricating fluid, and will never move upwardly far enough to pass through the seals and packing of the stuffing box.

In one embodiment of the invention, a suitable source of clean lubricating fluid is provided and is placed in communication with the annulus between the polished rod and the extension tube by a suitable conduit so that a constant supply of clean lubricating fluid is avail-

able to replenish the lubricating fluid which may be lost in minute amounts by extrusion through the seal at the lower end of the annulus or through the stuffing box seals. One embodiment of the invention also contemplates the inclusion in the stuffing box assembly of a suitable pressure responsive device and signaling means, such as a pressure switch having a bell connected in an electrical circuit therewith. The pressure switch is placed in communication with the lubricating fluid in the annulus and is responsive to fluctuations in the pressure of the lubricating fluid. The signaling means is electrically connected to said pressure switch so that variations in the pressure of the lubricating fluid in the first annulus will be signaled to an operator. This arrangement permits an operator to be apprised of the development of a leak in the seal at the lower end of the annulus between the polished rod and the extension tube since the lubricating fluid in this annulus is generally maintained at a lower pressure than the pressure prevailing in the tubing string, and loss of integrity of the seal at the lower end of the annulus results in oil from the tubing string infiltrating the annulus and causing an increase in the pressure therein.

The provision of the extension tube in the stuffing box assembly of the present invention permits a long column of clean lubricating fluid to be positioned around the polished rod at all times. The portion of the polished rod which wears by virtue of its passage through the metal seal at the lower end of the extension tube never is reciprocated into the stuffing box so as to induce wear in the stuffing box seals or the packing of the stuffing box. Moreover, these elements of the stuffing box are never subjected to contact with salt, sand or other corrosive, erosive or deleterious materials which may be carried into the box and through its seals by the polished rod since these materials are wiped from the polished rod by the metal to metal seal at the lower end of the extension tube, and also the polished rod is further cleaned in its movement through the body of clean lubricating fluid contained in the extension tube. In the polished rod assembly of the invention, the packing of the stuffing box need not be highly compressed since the packing need be only tight enough to wipe the clean lubricating fluid from the polished rod on the upstroke of the pump. In other words, the stuffing box per se acts merely as a wiper for surface dirt that collects on the polished rod after it is passed through the stuffing box on the upstroke. In the embodiment of the invention which includes the lubricating fluid reservoir and the pressure responsive signaling system, the stuffing box assembly is substantially automatic in its operation and functions to automatically apprise an operator of malfunction in the assembly prior to the time when the stuffing box per se becomes damaged in the slightest degree. The automatic aspects of the invention make it ideal for use in automatic lease operations and telemetering systems.

From the foregoing description of the invention, it will have become apparent that it is an important object of the present invention to provide a stuffing box assembly which is characterized by a longer and more trouble-free operating life than has been characteristic of stuffing boxes heretofore in use.

An additional object of the present invention is to provide a stuffing box assembly which automatically signals the development of a defect in the assembly.

An additional object of the present invention is to provide a stuffing box assembly which automatically appraises an operator of the development of conditions in the assembly which indicate that minor servicing is required prior to the time when the seals and packing of the stuffing box are damaged.

A further object of the present invention is to provide a stuffing box assembly which is better adapted for use in high pressure wells and in well systems operating at

high flow line pressures than have been stuffing boxes heretofore in use.

A further object of the present invention is to provide a stuffing box assembly which reduces the maintenance required since, in the present invention, frequent adjustment of the compression on the stuffing box packing is unnecessary.

In addition to the foregoing described objects and advantages of the invention, additional objects and advantages will be perceived as the following detailed description of the invention is read in conjunction with a perusal of the accompanying drawing.

In the drawing, the sole figure is a vertical sectional view through an oil well tubing string showing the manner in which the stuffing box assembly of the present invention is incorporated in said tubing string.

Referring now to the drawing in detail, reference character 10 designates a string of oil well production tubing which, as is well understood in the art, extends downwardly into the ground to a subterranean oil-bearing formation. Oil is pumped upwardly in the tubing string 10 by a sucker rod pump which is operated by reciprocating a string of sucker rods (not shown) in the tubing 10. The uppermost rod of the sucker rod string is termed the polished rod and is designated by reference character 12. The polished rod passes through a pumping T 14 which is threadedly engaged with the upper end of the tubing string 10 and customarily carries a threaded port 16 for connecting an oil flow line 18 thereto to permit the oil to be conveyed to storage. A second and smaller port 20 is usually provided in the pumping T 14 to permit a pressure gauge, test flow conduit or other ancillary equipment to be connected to the pumping T.

The stuffing box assembly of the present invention includes a stuffing box proper 22 of substantially conventional construction except as hereinafter described. The stuffing box 22 thus includes a housing 26 which carries a circumferentially extending internal flange 28 which supports a suitable packing element 30. In a preferred embodiment of this invention, the packing element 30 consists of a plurality of annular rings constructed of a synthetic resin material having high mechanical strength, good resistance to chemical corrosion and a low coefficient of friction with respect to the metal of the polished rod. An excellent plastic having these properties is a polyhalohydrocarbon, such as those sold under the trade names "Teflon and Kel-F. The bore through the packing material 30 is dimensioned to provide a sliding fit of the packing rings around the polished rod 12. However, in order to occasionally increase the degree to which the packing 30 is compressed in order to compensate for wear of the packing by repeated reciprocation of the polished rod 12 therethrough, a threaded cap member 32 is threadedly secured to the upper end of the stuffing box housing 26 and may be threaded downwardly to increase the compression on the packing material 30.

A tubular adapter coupling 34 which coaxially surrounds the polished rod 12 is connected at its upper end to the lower end of the stuffing box housing 26 and at its lower end to the upper end of the pumping T 14. The bore through the tubular adapter coupling 34 is of substantially larger diameter than the diameter of the polished rod 12 so that an annulus 35 exists around the polished rod and within the adapter coupling. A lubricating fluid reservoir 36 is placed in communication with the annulus 35 in the adapter coupling 34 through a suitable conduit 38 so that lubricating fluid may be introduced to the annulus from the reservoir for a purpose hereinafter described. In one embodiment of the invention, a pressure responsive device such as a pressure switch 40 is associated with the reservoir 36, conduit 38 and annulus 35 in a manner to permit the pressure switch to respond to variations in the pressure of lubricating fluid contained in these elements of the invention. In

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the embodiment of the invention illustrated in the drawing, the pressure switch 40 is in communication with the conduit 38 through a conduit 42. The pressure switch is connected to a suitable signaling means, such as a bell 43 through an electrical circuit.

Adjacent its lower end, the adapter coupling 34 carries a downwardly facing, internal shoulder 44 which extends circumferentially around the internal wall of the coupling. A brass wiper ring 46 is retained against the shoulder 44 by an elongated extension tube 50 which is threaded into the adapter coupling 34 at the lower end thereof and bears at its upper end against the brass ring 46. The extension tube 50 extends through the pumping T 14 and downwardly into the tubing string 10 for a substantial distance. The internal and external diameters of the extension tube 50 are such that a first annulus 51 is defined between the extension tube and the polished rod 12, and a second annulus 52 is defined between the extension tube and the tubing string 10. Since the diameter of the brass wiper ring 46 is larger than the diameter of the polished rod 12, the annulus in the adapter coupling 34 and the annulus defined between the polished rod and the extension tubing 50 communicate with each other through the central aperture of the brass ring 46.

At its lower end, the extension tube 50 carries a suitable sealing means 53 which closes with a fluid tight seal, the annulus 51 which is defined between the polished rod 12 and the extension tube 50. In a preferred embodiment of the invention the sealing means 53 takes the form of an elongated metal sealing sleeve 54 which is secured inside the extension tube 50 by a lock nut 55 at the lower end of the extension tube and which is provided with an axial bore therethrough for slidably receiving the polished rod 12. The metal sealing sleeve 54, which may be formed of cast iron, hardened steel or chrome plated steel, forms a fluid tight metal to metal seal with the polished rod 12 and prevents fluid in the tubing string 10 from infiltrating the annulus 51 between the polished rod 12 and the extension tube 50. The extension tube 50 is preferably constructed of a material which is capable of some flexure to permit it to accommodate to slight misalignment or distortion of the polished rod 12.

OPERATION

The stuffing box assembly of the present invention is secured to the tubing string and pumping T of the well in a manner similar in many respects to the method of securement of a conventional stuffing box. Thus, the stuffing box housing 26 is positioned around the polished rod 12 and in sealing engagement therewith and is connected through the tubular adapter coupling 34 to the top of the pumping T 14. The polished rod is further extended through the sealing means 53 located at the bottom of the extension tube 50. The annulus 35 in the tubular adapter coupling 34 and around the polished rod 12, as well as the annulus 51 between the polished rod and the extension tube 50, are then filled with a clean lubricating fluid, such as refined petroleum. The lubricating fluid reservoir 36 and the conduits 38 and 42 are also filled with lubricating fluid so that a constant supply of surplus fluid is available to replace the lubricating fluid which is depleted in the annuli 35 and 51.

With the stuffing box assembly of the invention mounted on the tubing string 10 and pumping T 14 in the manner described, operation of the sucker rod pump used to produce the oil may be commenced. During operation of the pump, the string of sucker rods including the polished rod 12 at the upper end thereof will be reciprocated in the tubing string 10. As the polished rod 12 reciprocates through the sealing means 53 at the lower end of the extension tube 50 and through the stuffing box 22, it is constantly bathed in the lubricating fluid which fills the annulus 35 in the tubular adapter coupling 34, and the annulus 51 between the polished rod 12 and the extension tube 50. Since none of the production

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fluid moving upwardly in the tubing string 10 is permitted to enter these spaces, the portion of the polished rod which is always above the sealing means 53 is not subjected to corrosive materials carried by the production fluid, nor is it abraded by sand or other solid particles entrained in the production fluid. Moreover, the distance from the sealing means 53 to the stuffing box housing 26 is preferably approximately the same length as the stroke of the pump so that the portion of the polished rod 12 which moves through the sealing means 53 never passes through the packing 30 in the stuffing box housing 26. In this way, should the polished rod become worn as a result of repeated sliding movement through the sealing means 53 at the lower end of the extension tube 50, the worn portion of the polished rod will not abrade or destroy the packing 30 in the stuffing box housing 26.

It will also be apparent that the extension tube 50 and its associated sealing means 53 function to take the pressure exerted by the production fluid moving upwardly in the tubing string 10 and to relieve the stuffing box 22 of this pressure. Thus, the function of the stuffing box packing element 30 becomes primarily that of wiping away dust which may settle on that portion of the polished rod 12 which is outside the stuffing box during the upward stroke of the pump. The packing 30 need not be tightly compressed to accomplish this function and the loss of small amounts of the lubricating fluid through the stuffing box 22 is not a matter of serious concern. As small amounts of the lubricating fluid are lost from the annuli 35 and 51 as a result of extrusion through the stuffing box 22 or heat losses, the lost oil is replenished from the lubricant reservoir 36.

In the event that the pump is used to pump primarily gas rather than liquid as a result of temporary down hole conditions, such as those occurring in a pumping off operation, the polished rod 12 will not be permitted to become dry as would be the case with conventional stuffing boxes heretofore in use since the lubricating fluid in the annuli 35 and 51 continuously wets the polished rod. This prevents the stuffing box packing from being burned out.

In the embodiment of the invention which incorporates the pressure switch 40 and bell 43 or other signaling device, the invention functions to apprise an operator of the fact that a small leak or other loss of integrity of the sealing means 53 has developed. This automatic signaling function of the assembly is effected through the maintenance, during normal operation, of the lubricating fluid in the annuli 35 and 51 at a lower pressure than the pressure obtaining in the tubing string 10 outside the extension tube 50. Thus, any failure of the sealing means 53 will result in pressure equalization across the seal with the result that an increase in the pressure of the lubricating fluid in the annuli 35 and 51 and in the conduits 38 and 42 will result. This increase in pressure will actuate the pressure switch 40 so that the circuit to the signal means 43 is closed. It will be apparent that failure of the sealing means 53 will in practically every instance precede failure of the stuffing box 22 by destruction of the packing 30 and seals thereof. Therefore, when the sealing means 53 develops a slight leak, it will be possible to easily replace the sealing means and thus avoid subjecting the stuffing box 22 and its internal elements to destruction occasioned by the subjection of the portion of the polished rod 12 moving therethrough to corrosion or abrasion by the production fluids moving upwardly in the tubing string 10.

The extension tube 50 is preferably made of a material which is slightly flexible so that departures of the polished rod 12 from linear movement within the tubing string 10 may be followed by the extension tube 50 as a result of its flexure. Also, the brass guide ring 46 functions to guide the movement of the polished rod 12 in the tubular adapter coupling 34 so that axial misalign-

ment of the polished rod as it moves through the stuffing box 22 is minimized.

From the foregoing description of the invention, it will be perceived that the present invention provides a novel and highly useful stuffing box assembly for attachment to, and use in combination with, oil well tubing strings and the pumping T customarily located at the upper end thereof. The assembly is relatively inexpensive to construct and is characterized by an operating life which is substantially longer than those of stuffing boxes heretofore in use. Moreover, the stuffing box assembly of the invention allows maintenance and adjustment of well head apparatus to be reduced, and provides an automatic warning system to apprise operators of malfunction of the stuffing box assembly before any serious or irreparable damage thereto has resulted.

Although a certain degree of particularity has been employed in describing the details of construction of certain exemplary embodiments of the present invention, it will be understood that the details of construction hereinbefore described may be modified in varying degrees without departure from the basic principles which underlie the invention. It is therefore our intention that all such modifications and innovations as are made in the described structure of the present invention without departure from the basic principles and concepts of the invention shall be circumscribed by the spirit and scope of the invention except as the same may be necessarily limited by the appended claims or reasonable equivalents thereof.

What is claimed is:

1. Apparatus for capping the upper end of a string of oil well tubing and lubricating a polished rod extending therethrough comprising:

- (a) a pumping T connected to the upper end of said tubing string and having an oil flow line extending therefrom;
- (b) a stuffing box around the polished rod and connected to the upper end of the pumping T;
- (c) packing material in the stuffing box and sealingly surrounding the polished rod;
- (d) a tubular member extending through the pumping T around the polished rod and positioned inside said tubing string, said tubular member having an inside and outside diameter such that a first annulus is defined between the tubular member and polished rod, and a second annulus is defined between the tubular member and the tubing string;
- (e) first sealing means at the lower end of said tubular member closing the lower end of said first annulus;
- (f) second sealing means adjacent the upper end of said tubular member closing said second annulus to divert oil flowing in said annulus into said oil flow line;
- (g) a source of lubricant in nonadjoining separation from said polished rod; and
- (h) conduit means placing said source of lubricant in communication with the interior of said tubular member whereby said first annulus may be filled with lubricant.

2. Apparatus as claimed in claim 1 wherein the distance between said first sealing means and said packing material is at least as great as the length of stroke of the polished rod.

3. Apparatus as claimed in claim 1 wherein said tubular member is constructed of a flexible material to permit said tubular member to move transversely in said tubing string as said polished rod develops misalignment.

4. Apparatus as claimed in claim 1 wherein said first sealing means comprises a metal sealing sleeve around said polished rod and secured in said tubular member, said metal sealing sleeve forming a metal to metal seal with said polished rod.

5. In combination with a stuffing box,

(a) a tubular adapter coupling connected at one of its ends to the stuffing box and adapted to be connected at its other end to a pumping T at the upper end of a string of oil well tubing;

(b) an extension tube connected at one of its ends to said adapter coupling and having its bore communicating with the bore of said adapter coupling;

(c) a tubular sealing member having an axial bore therethrough dimensioned to slidably receive the polished rod of an oil well pump sucker rod string and positioned inside said extension tube at its end opposite that end connected to said adapter coupling; and

(d) a source of lubricating fluid in nonadjoining separation from said polished rod, and means connecting said source to said adapter coupling for feeding lubricating fluid to said adapter coupling and said extension tube.

6. The combination claimed in claim 5 wherein the combined length of said extension tube and adapter coupling is substantially equal to the length of stroke of an oil well pump in which said combination is incorporated.

7. In an oil well pump assembly of the type having a production tubing string, a pumping T adjacent the top of said tubing string and adapted for connection to an oil flow line, a string of sucker rods extending downwardly in said tubing string, a polished rod connected to said sucker rod string at the upper end thereof, and a stuffing box sealingly surrounding said polished rod and connected to said tubing through said pumping T, the improvement which comprises:

(a) an extension tube extending through said pumping T downwardly into said tubing string around said polished rod and defining with said polished rod a first annulus and with said tubing string a second annulus;

(b) first sealing means positioned inside the lower end of said extension tube and closing the lower end of said first annulus;

(c) second sealing means adjacent the upper end of said extension tube and closing said second annulus at a point adjacent the upper end of said pumping T to divert oil flowing in said second annulus into an oil flow line leading from said pumping T; and

(d) a lubricating fluid source in nonadjoining separation from said polished rod and means placing said source in communication with said first annulus.

8. The improvement in an oil well pump as claimed in claim 7 and further characterized to include

(a) a lubricating fluid reservoir; and

(b) a conduit placing said lubricating fluid reservoir in communication with said first annulus whereby lubricating fluid in said annulus may be automatically replenished as it is diminished.

9. Apparatus for capping the upper end of a string of oil well tubing and lubricating a polished rod extending therethrough comprising:

(a) a pumping T connected to the upper end of said tubing string and having an oil flow line extending therefrom;

(b) a stuffing box around the polished rod and connected to the upper end of the pumping T;

(c) packing material in the stuffing box and sealingly surrounding the polished rod;

(d) a tubular member extending through the pumping T around the polished rod and positioned inside said tubing string, said tubular member having an inside and outside diameter such that a first annulus is defined between the tubular member and polished rod, and a second annulus is defined between the tubular member and the tubing string;

(e) first sealing means at the lower end of said tubular member closing the lower end of said first annulus;

(f) second sealing means adjacent the upper end of said tubular member closing said second annulus to

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divert oil flowing in said annulus into said oil flow line;

- (g) a source of lubricant;
 - (h) conduit means placing said source of lubricant in communication with the interior of said tubular member whereby said first annulus may be filled with lubricant; and
 - (i) pressure responsive signal means responsive to the pressure of said lubricant in said first annulus for signaling variations in the pressure of the lubricant in said first annulus.
10. In combination with a stuffing box,
- (a) a tubular adapter coupling connected at one of its ends to the stuffing box and adapted to be connected at its other end to a pumping T at the upper end of a string of oil well tubing;
 - (b) an extension tube connected at one of its ends to said adapter coupling and having its bore communicating with the bore of said adapter coupling;
 - (c) a tubular sealing member having an axial bore therethrough dimensioned to slidably receive the polished rod of an oil well pump sucker rod string and positioned inside said extension tube at its end opposite that end connected to said adapter coupling;
 - (d) a source of lubricating fluid, and means connecting said source to said adapter coupling for feeding lubricating fluid to said adapter coupling and said extension tube; and
 - (e) pressure responsive signal means responsive to the pressure of the lubricating fluid in said adapter coupling and extension tube for signaling variations in said pressure.

11. The combination claimed in claim 10 wherein said tubular sealing member comprises a metal sealing sleeve secured in the bore through said extension tube at the lower end of said extension tube.

12. In an oil well pump assembly of the type having a production tubing string, a pumping T adjacent the top of said tubing string and adapted for connection to an oil flow line, a string of sucker rods extending downwardly in said tubing string, a polished rod connected to

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said sucker rod string at the upper end thereof, and a stuffing box sealingly surrounding said polished rod and connected to said tubing through said pumping T, the improvement which comprises:

- (a) an extension tube extending through said pumping T downwardly into said tubing string around said polished rod and defining with said polished rod a first annulus and with said tubing string a second annulus;
- (b) first sealing means positioned inside the lower end of said extension tube and closing the lower end of said first annulus;
- (c) second sealing means adjacent the upper end of said extension tube and closing said second annulus at a point adjacent the upper end of said pumping T to divert oil flowing in said second annulus into an oil flow line leading from said pumping T;
- (d) a lubricating fluid in said first annulus;
- (e) a lubricating fluid reservoir;
- (f) a conduit placing said lubricating fluid reservoir in communication with said first annulus whereby lubricating fluid in said annulus may be automatically replenished as it is diminished; and
- (g) a pressure responsive switch responsively connected to said first annulus for responding to fluctuations in the pressure of said lubricating fluid in said first annulus.

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