April 21, 1942. R. C. JOHNSTON 2,280,408

POLISH ROD HANGER AND ROTATOR

Filed Feb. 6, 1940 2 Sheets-Sheet 1

Fig. 1

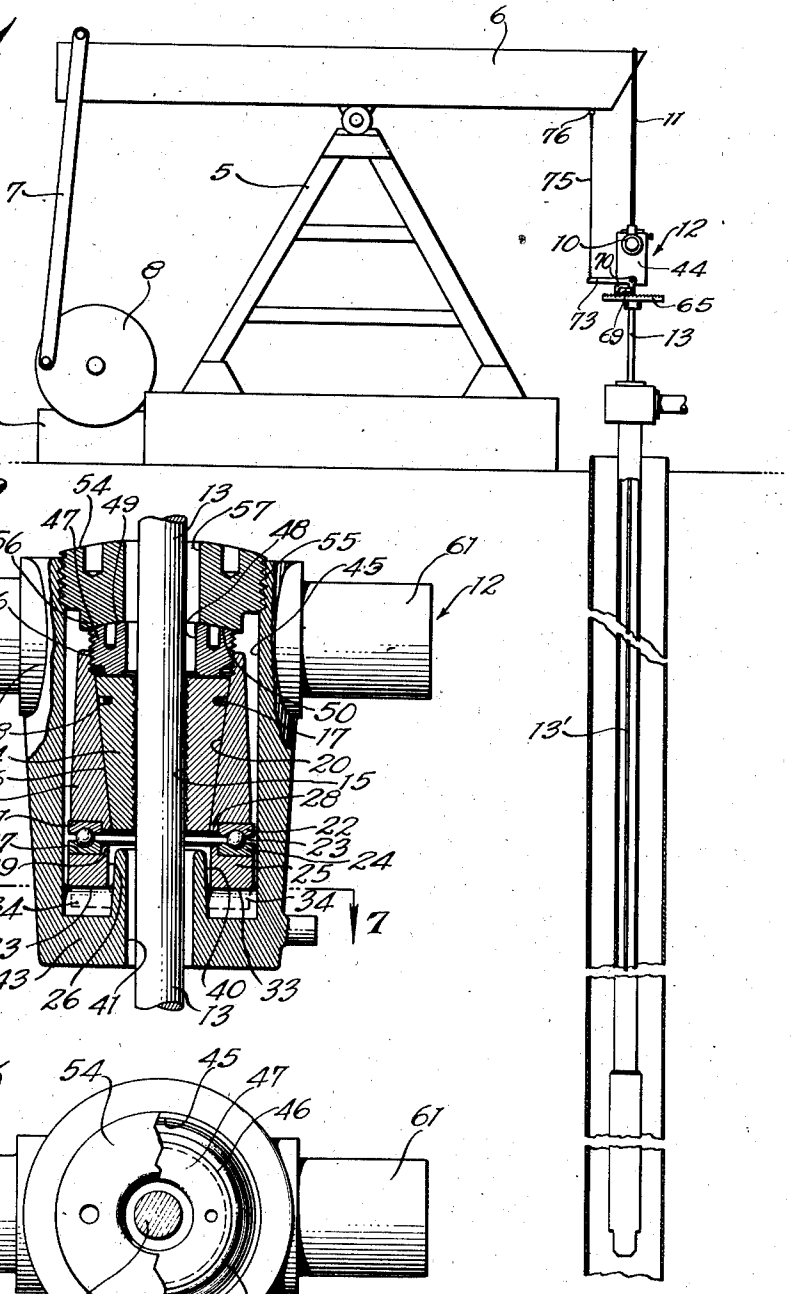
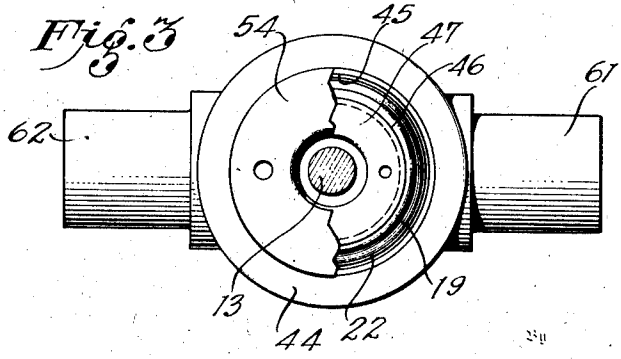


Fig. 2

Fig. 3



Inventor,
ROBERT C. JOHNSTON.

By James M. Abbett

Attorney

April 21, 1942. R. C. JOHNSTON 2,280,408

POLISH ROD HANGER AND ROTATOR

Filed Feb. 6, 1940 2 Sheets-Sheet 2

Fig. 4

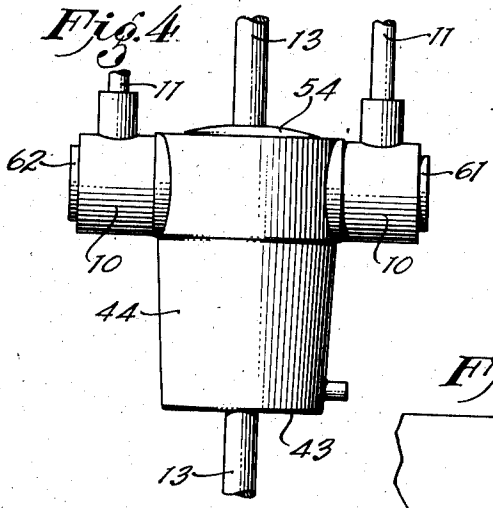


Fig. 7.

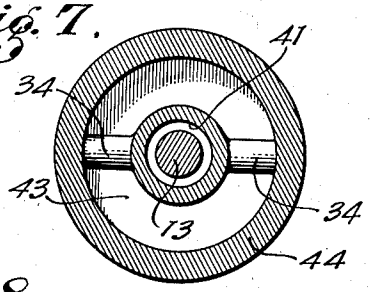


Fig. 8

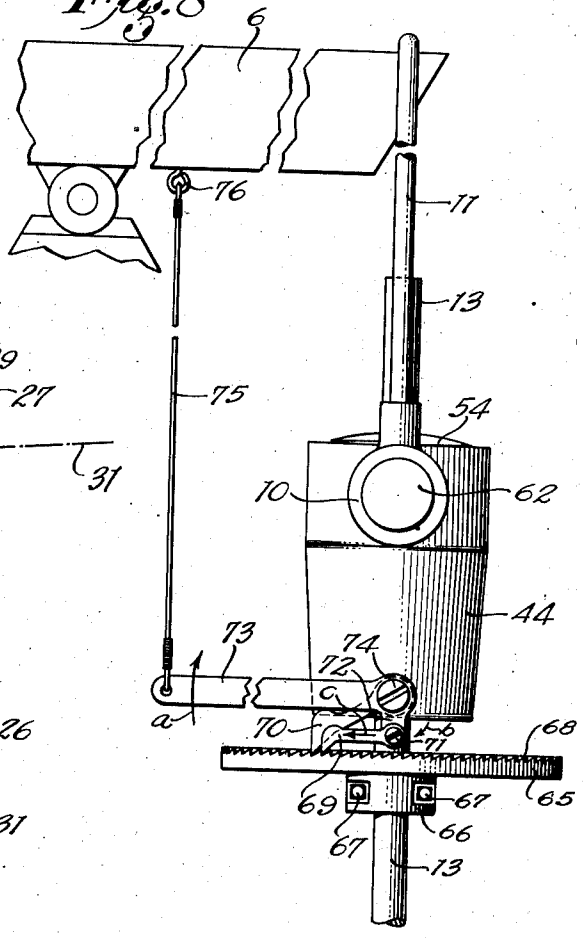


Fig. 5

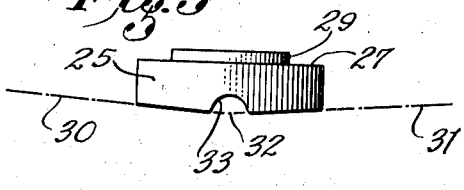
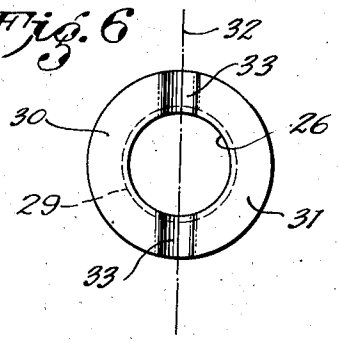


Fig. 6



Inventor,
ROBERT C. JOHNSTON.

By James M. Abbett

Attorney

Patented Apr. 21, 1942 2,280,408

UNITED STATES PATENT OFFICE

2,280,408

POLISH ROD HANGER AND ROTATOR

Robert C. Johnston, Tyler, Tex.

Application February 6, 1940, Serial No. 317,548

12 Claims. (Cl. 255—14)

This invention relates to oil well production equipment and particularly pertains to Polish rod hangers of the type shown in U. S. Letters Patent No. 2,122,944 issued to me July 5, 1938.

In the use of polish rod hangers it is desirable to provide a gripping structure for the polish rod of the well pump whereby the rod may have some latitude of movement with relation to the hanger both horizontally and vertically in order to accommodate lack of precision in lateral alignment of the rod hanger during its movement with relation to the polish rod itself, and in order to make it possible for the polish rod hanger to adjust itself automatically with relation to the polish rod when, for any reason, the stroke of the polish rod may be shortened. This last named condition may occur when the working barrel has received an objectionable accumulation of silt and sand which would prevent the piston of the pump from pursuing a full stroke. It is the object of the present invention, therefore, to provide a polish rod hanger having means for automatically gripping the polish rod without the use of any rigid attaching means, and which will flexibly hold the polish rod in a manner to permit the rod to automatically adjust itself to conditions in the well which might tend to cause variation in the stroke of the rod, rotation of the rod and misalignment thereof, the structure thereby eliminating the tendency for the pump rod to buckle or for it to be placed under undue bending torsional or longitudinal strains, thereby minimizing the wear on the rod parts as well as the hanger, and at the same time insuring that undue stresses and strains will not be imparted to the working barrel piston and the working barrel, and by which excessive wear might take place in the working barrel parts.

It is another object of the invention to provide means associated with the polish rod and its hanger whereby the rod will be given positive rotational movement on each stroke of the rod, said movement representing an increment of the circumference of the rod whereby wear will be eliminated at any one point in the rod, and such wear and binding which might be imposed upon the rod will be distributed uniformly thereabout.

The present invention contemplates the provision of a rod hanger adapted to be supported by the reins of a pump jack, said hanger being provided with means for gripping a polish rod on the up-stroke of the hanger and for automatically releasing the polish rod when the downward movement of the hanger is in excess of the possible stroke of the polish rod, the structure also embodying provisions whereby the gripping means may have free rotational action, thus eliminating torsional strain in the polish rod and in the pump rods and adjustable lateral movement to accommodate misalignment of the polish rod and the pump rods, the structure furthermore embodying means whereby the polish rod will be positively rotated incident to the pumping operation.

The invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a view indicating a pump jack, the rod hanger structure and a pumping device in a well casing and discloses the application of the present invention.

Fig. 2 is a view in central vertical section showing the details of construction of the rod hanger.

Fig. 3 is a view in plan showing the rod structure and indicating the arrangement of the lock nut for holding the slips.

Fig. 4 is a view in side elevation showing the assembled hanger and the elements of the reins supporting the same.

Fig. 5 is a view in side elevation showing the rock plate disposed beneath the slips.

Fig. 6 is a view in plan showing the under face of the rock plate and the rocker seats therein.

Fig. 7 is a view in plan showing the rocker bars for the rocker plate seats.

Fig. 8 is a view in side elevation showing the rotating element assembly for rotating the polish rod.

Referring more particularly to the drawings, 5 indicates a Samson post of a pump jack, which supports a walking beam 6. The walking beam is oscillated by a pitman rod 7 connected with the driving disc 8 of a pump unit 9. The numeral 10 indicates the bearing portions of the reins 11 by which the pump jack is operatively connected with the structure with which the present invention is concerned. Supported between the bearing members 10 and suspended therefrom is a rod hanger 12 with which the present invention is particularly concerned. Extending through the rod hanger, as indicated in solid lines in Fig. 3 and dotted lines in Fig. 1, is a polish rod 13. It is understood that the polish rod 13 is connected to the upper end of a string of pump rods 13'. The lower end of the string of pump rods connects with a reciprocating piston moving in a pump working barrel, the details of construction of which are of common knowledge in the oil industry.

In the operation of reciprocating pump mechanism used in oil wells it often occurs that an accumulation of sand and silt takes place in the bottom of the working barrel which would prevent the piston from moving to the lower end of its stroke. In usual pumping structures the polish rod is rigidly connected at its upper end to a crosshead or rein structure so that in the event of accumulation of material in the lower end, which would shorten the effective stroke of the pump rod, there would be a tendency for the rod to buckle. In my U. S. Letters Patent No. 2,122,944 slip means were provided to make it possible for the rod hanger to automatically adapt itself to rod conditions and to compensate for differences between the pumping stroke of the rod hanger and the actual pumping movement of the pump rod. Such a structure is embodied in the present invention with additional improvements, including means for rotating the pump and polish rods automatically.

The slips are here indicated at 14 in Fig. 2 of the drawings. These slips may be of any desired number and have inner serrated faces 15 and outer tapered back portions 16, a cross-section of which slips is arcuate. The slips are yieldably urged toward their innermost position by an annular spring clip 17 which is in the form of a split spring ring fitting within an arcuate groove 18 formed in the outer face 16 of each of the slips. The slips are mounted within a slip bowl 19 which has a frusto-conical inner face 20 against which the outer arcuate faces 16 of the slips rest and along which they may move toward a gripping position. The bowl is formed with an annular seat 21 around its lower end to receive a ball or roller race 22. A set of ball or roller bearings 23 are interposed between the race 22 and a lower race 24, thus providing an anti-friction thrust bearing for the lower end of the bowl. The lower race in turn rests upon a rock plate 25. This rock plate is an annular member having a central opening 26 through it and being formed with a shoulder 27 to receive the lower race 24. The inner diameters of the bearing races 22 and 24 are such as to insure that tubular centering extensions 28 and 29 will occur upon the contiguous ends of the bowl 19 and the rock plate 25. As indicated in Fig. 5 of the drawings, the lower face of the rock plate is formed in two converging planes 30 and 31. These planes converge along the equatorial center line of the plate, as indicated at 32. Thus, the plate is free to rock laterally of the center line. In order to facilitate in this rocking motion rocker seats 33 are formed as semi-cylindrical indentations in the lower face of the rock plate and with their centers in register with the center line 32. The rocker plate seats 33 rest upon the rocker bars 34. As shown in Fig. 7, these bars are an integral part of end wall 43 of a cylindrical rod hanger housing 44. The central axes of rocker bars 34 are in the same vertical plane with the axes of trunnions 61 and 62. The housing 44 has a cylindrical center bore 45 within which the rod slip assembly previously described is housed. The end wall of the housing has a central bore 41. The bore 41 is through a tubular part of the housing 44 extending upward to make a channel face 40 to hold lubricants for rocker seats 33 and rocker bars 34. The upper end of the slip bowl 19 is internally threaded at 46 and receives a slip lock nut 47 which prevents the retraction of the slips 14 from the bowl. This lock nut has a central opening 48 therein to accommodate the polish rod 13 and has an annular spheroidal face 49 against which annular spheroidal face 50 of a housing cover 54 rests. The housing cover 54 is threaded into the top of the housing 44 with threads 55 and has a downwardly projecting cylindrical length 56 which is longitudinally adjustable by the threads 55. This will provide clearance between the annular spheroidal faces 49 and 50. This will permit rocking of the slip unit on rockers 34 and also rotation of the slip bowl 19.

As shown in Figs. 1 and 2 of the drawings, an enlarged bore 57 extends through the length of the cap 54 and thus provides sufficient clearance for the polish rod 13, which is of smaller diameter. This also makes it possible for the housing cover 54 to be conveniently screwed into position. The housing cover 54 may be held in a locked position by a set screw (not shown) which extends through the wall of the housing and engages the threaded portion 55 of the cover. In order to facilitate in rotating the retaining nut 47 and housing cover 54, these members are provided with cored holes to receive a spanner wrench.

The housing 44 is provided at a point near its upper end with a pair of trunnions 61 and 62 which are embraced by the bearings on elements 10. By this arrangement the housing is free to rock around a horizontal axis as supported by the reins and the moving parts of the pump jack.

It has been found desirable in the operation of the invention to rotate the polish rod and the pump rods suspended thereon incident to the pumping operation. This insures that any wear imposed upon the pump rods will be uniformly distributed around the circumference of the structure and that there will not be the probability of binding or wear at any one point. This prevents flat spots from being worn on the rods and also keeps the rod joints screwed tight. The means for accomplishing this result is indicated in Figs. 1 and 8. Here it will be seen that a ratchet plate 65 is fastened upon the polish rod 13 directly beneath the housing structure 44. The ratchet plate is made in two halves and is formed with hub sections 66 which may be placed in an embracing position around the polish rod and there gripped by bolts 67. Radially disposed ratchet teeth 68 are cut in the upper face of the ratchet disc 65 and are engaged by a rotator pawl 69 and a lock dog 70. The rotating pawl is mounted on a horizontally extending pin 71 carried upon a lug 72. The lug 72 is in the form of a short lever arm formed integral with a cantilever bar 73 with which it is disposed at right angles. The cantilever bar is mounted upon a horizontally disposed pivot pin 74 extending radially from the side of the housing 44 of the hanger and adjacent the lower end thereof. The cantilever bar 73 extends horizontally and at its outer free end is connected with an operating cable 75 which leads vertically to a connection 76 on the walking beam 6 and on the end of the walking beam adjacent to the reins 11. The lock dog 70 is a pawl-shaped member free to rotate on the pivot 74 and held in its lowermost position by gravity. This pawl prevents reverse rotation of the ratchet disc 65 while the locking dog 69 is moving ahead and rotating the ratchet disc 65 and the polish rod 13.

In operation of the present invention the rod hanger is assembled as shown in Fig. 1 of the drawings and is suspended upon the reins 10.

The polish rod 13 extends through the rod hanger but is in nowise permanently fastened to the hanger housing. When the pumping mechanism is on its up-stroke the teeth 15 of the slips 14 will engage the outer surface of the polish rod and cause the polish rod to be lifted with the hanger as though it were fastened thereto. During this lifting operation the slips 14 will tend to wedge downwardly along the faces of the bowl 19 and will be yieldably held against the rod by the spring ring 17. The weight of the rods will thus be imposed upon the slips and they in turn will be supported by the bowl. The bowl rests upon the anti-friction thrust bearing comprising the bearing races 22 and 24 and the rollers 23. Thus, the bowl with the slips gripped therein is free to rotate around the longitudinal axis of the polish rod, thus eliminating any possibility for holding the rod against rotation which would set up torsional strains in the rod and might cause a fracture of the pump rod at some point in its length or the unscrewing of a rod joint. By the arrangement here disclosed there will be no resistance to rotation, thus permitting the entire pump rod structure to freely rotate if desired. In the event that the rod hanger moves out of alignment with the rectilinear path of travel of the rod there is a tendency for the rod to be placed under bending strain. In the present case this is obviated to a desired extent by the rocking plate 25 resting upon the rocker bars 34.

In assembling the device the rocker plate 25 has been set in the bottom of the housing 44 with seats 33 resting on the rocker bars 34. Thus, as the hanger moves up and down and tends to swing around the axis of the trunnions 61 and 62 any misalignment between the polish rod 13 and the hanger would cause relative movement of these members in a plane at right angles to that of the pivotal axis of the trunnions and the equatorial plane of the rocker bars 34. This equatorial plane, as previously described, is also occupied by the equatorial line 32 dividing the two plane faces 30 and 31 of the rock plate 25. As a result the rock plate 25 may rock on the rocker bars 34 to permit the bowl 19 and the slips to swing in accord with the relative swinging movement occurring between the rod 13 and the hanger structure. This swinging will cause the slip bowl assembly to move its arcuate face 49 in the plane with the arcuate face 50 of the housing cover retaining member 54, it being understood that this arcuate face is struck from a point represented by the intersection of the longitudinal center line of the rocker bars 34 and the plane in which the centers of the rockers 34 lie.

It will be evident that a lubricant may be placed in or on the surface 49 and 50 so that the moving faces of the members may be lubricated. It is also to be understood that the channel 40 formed in the upper face of the bottom plate of housing 44 can be filled with lubricant so that the rocker bars 34 may be sufficiently lubricated.

On the down stroke of the pump mechanism it may occur that the pump rod and the polish rod 13 may not be free to move downwardly a distance represented by the downward movement of the hanger, in which event the hanger will move downwardly over the polish rod 13 since the slips 14 will tend to move upwardly as yieldably resisted by the spring 17. When the polish rod hanger changes the direction of its travel and begins to move upwardly the slips will grip the polish rod 13 again and lift the rod.

As previously explained, it is desirable to cause the polish rod to rotate as it reciprocates. This is done automatically. The walking beam oscillates vertically and in doing so reciprocates the polish rod. The reins 11 are connected to the upper forward edge of the walking beams 6 and the cable 75 is connected beneath the walking beam and at a point materially removed from the end of the beam and toward the Samson post. Thus, as the end of the walking beam connected to the polish rod swings downwardly it describes a larger arc than the arc described by the cable support, with the result that the member 73 will be drawn upwardly at its outer end and will swing in the direction of the arrow *a* indicated in Fig. 8. This will cause the lug 72 to swing in the direction of the arrow *b* and move the rotator pawl 69 in the direction of the arrow *c*, with the result that the end point of the pawl 69 will engage the teeth 68 on the ratchet disc 65 and force this disc to rotate. During this movement the point of the lock dog 70 will ride over the ratchet teeth and will remain in engagement with one of the ratchet teeth when the pawl 69 has reached the end of its stroke. This takes place when the polish rod hanger is at the lower end of its stroke. It will be recognized that the polish rod hanger is free to rotate in view of the fact that the polish rod is mounted within the slip unit and that the slip unit is free to rotate. When the polish rod hanger moves toward its uppermost position the reins 11 and the cable 75 will readjust themselves, as shown in Fig. 1 of the drawings. During such readjustment the member 73 will swing downwardly by gravity in a direction opposite to the direction of the arrow *a*. This will swing the lug 72 to its original position and will draw the pawl 69 in the opposite direction to the arrow *c* and cause the free end of the pawl to ride over the ratchet teeth preparatory to taking another position of engagement with the ratchet teeth so that upon the next down-stroke of the polish rod the pawl will be set for a new rotational movement. It will be seen that the length of the bar 73 and the length of the lug 72 as well as the spacing of the reins 11 from the cable 75 will determine the length of stroke of the pawl so that as the pawl moves to a new position upon each reciprocation of the polish rod it will ride over a predetermined number of ratchet teeth. This will insure that the pawl will cause the ratchet disc 65 to be rotated a predetermined degree at each reciprocation of the polish rod and on the down-stroke thereof. By reason of the pawl arrangement with the ratchet disc the polish rod will always be free to rotate in the feeding direction of the pawl 69.

It will thus be seen that the rod hanger structure here disclosed provides simple means for gripping and moving a polish rod and the pump rods associated therewith, and that it is not only possible for the rod hanger to automatically adjust itself in proper gripping relation to the polish rod but also will permit free rotation of the polish rod and relative lateral movement between the polish rod and the rod hanger whereby lateral stress and strain is eliminated. It will also be recognized that due to the mounting of the polish rod, whereby it may freely rotate and also may be positively rotated, that the polish rod will not wear flat in any one position and

all of its joints will be maintained in a tightly screwed position.

While I have shown the preferred form of my invention as now known to me, it will be understood that various changes may be made in combination, construction, and arrangement of parts by those skilled in the art, without departing from the spirit of my invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In combination with a pump polish rod, a hanger having reciprocating movement, said hanger including a housing, means carried thereby for engaging the polish rod on the up-stroke of the hanger to cause the rod and hanger to move in unison, and means interposed between the engaging means and the housing for permitting relative lateral movement between the engaging means and the housing whereby the longitudinal axis of the polish rod may move laterally with relation to the longitudinal axis of the hanger.

2. In combination with a pump polish rod, a hanger having reciprocating movement, said hanger including a housing, means carried thereby for engaging the polish rod on the up-stroke of the hanger to cause the rod and hanger to move in unison, means interposed between the engaging means and the housing for permitting relative lateral movement between the engaging means and the housing whereby the longitudinal axis of the polish rod may move laterally with relation to the longitudinal axis of the hanger, and anti-friction means rotatably supporting the engaging means.

3. In combination with a polish rod, a hanger by which the polish rod is operatively connected to a pumping mechanism, said hanger being supported to swing upon a horizontal axis, a housing for the hanger through which the polish rod extends, gripping means within the housing for engaging the polish rod and causing it to move in unison with the hanger, and cooperating means with the gripping means whereby the gripping means may oscillate at right angles to the horizontal axis of the hanger to permit relative swinging movement between the hanger and the polish rod while it is gripped.

4. In combination with a polish rod, a hanger by which the polish rod is operatively connected to a pumping mechanism, said hanger being supported to swing upon a horizontal axis, a housing for the hanger through which the polish rod extends, gripping means within the housing for engaging the polish rod and causing it to move in unison with the hanger, cooperating means with the gripping means whereby the gripping means may oscillate at right angles to the horizontal axis of the hanger to permit relative swinging movement between the hanger and the polish rod while it is gripped, and anti-friction bearing means included within the structure of the oscillating means.

5. In combination with a polish rod, a hanger by which the polish rod is operatively connected to a pumping mechanism, said hanger being supported to swing upon a horizontal axis, a housing for the hanger through which the polish rod extends, gripping means within the housing for engaging the polish rod and causing it to move in unison with the hanger, cooperating means with the gripping means whereby the gripping means may oscillate at right angles to the horizontal axis of the hanger to permit relative swinging movement between the hanger and the polish rod while it is gripped, anti-friction bearing means included within the structure of the oscillating means, and retaining means for the gripping means, said retaining means acting to guide the gripping means in its oscillation.

6. In combination with a polish rod, a hanger by which the polish rod is operatively connected to a pumping mechanism, said hanger being supported to swing upon a horizontal axis, a housing for the hanger through which the polish rod extends, gripping means within the housing for engaging the polish rod and causing it to move in unison with the hanger, cooperating means with the gripping means whereby the gripping means may oscillate at right angles to the horizontal axis of the hanger to permit relative swinging movement between the hanger and the polish rod while it is gripped, anti-friction bearing means included within the structure of the oscillating means, retaining means for the gripping means, said retaining means acting to guide the gripping means in its oscillation, and anti-friction bearing means permitting free rotation of the gripping means within the housing.

7. In combination with a pump polish rod, a rod hanger by which the polish rod is operatively connected to a pumping mechanism, said hanger including a housing, trunnions carried by the housing to provide support for the housing by the pumping means and to provide a horizontal pivot for the housing, a slip structure within the housing including a bowl mounted loosely within the housing, means supporting the bowl to permit the bowl to move laterally of the longitudinal axis of the housing while supported by the housing, and slip members carried by the bowl to engage the pump polish rod and to cause it to move with the bowl.

8. In combination with a pump polish rod, a rod hanger by which the polish rod is operatively connected to a pumping mechanism, said hanger including a housing, trunnions carried by the housing to provide support for the housing by the pumping means and to provide a horizontal pivot for the housing, a slip structure within the housing including a bowl mounted loosely within the housing, means supporting the bowl to permit the bowl to move laterally of the longitudinal axis of the housing while supported by the housing, and slip members carried by the bowl to engage the pump polish rod and to cause it to move with the bowl, said slip members having longitudinally tapered back faces fitting into a correspondingly tapered seat in the bowl.

9. In combination with a pump polish rod, a rod hanger by which the polish rod is operatively connected to a pumping mechanism, said hanger including a housing, trunnions carried by the housing to provide support for the housing by the pumping means and to provide a horizontal pivot for the housing, a slip structure within the housing including a bowl mounted loosely within the housing, means supporting the bowl to permit the bowl to move laterally of the longitudinal axis of the housing while supported by the housing, slip members carried by the bowl to engage the pump polish rod and to cause it to move with the bowl, said slip members having longitudinally tapered back faces fitting into a correspondingly tapered seat in the bowl, and means yieldably holding the slip members in their innermost position.

10. In combination with a pump polish rod, a rod hanger by which the polish rod is operative-

ly connected to a pumping mechanism, said hanger including a housing, trunnions carried the housing to provide support for the housing by the pumping means and to provide a horizontal pivot for the housing, a slip structure within the housing including a bowl mounted loosely within the housing, means supporting the bowl to permit the bowl to move laterally of the longitudinal axis of the housing while supported by the housing, slip members carried by the bowl to engage the pump polish rod and to cause it to move with the bowl, said slip members having longitudinally tapered back faces fitting into a correspondingly tapered seat in the bowl, means yieldably holding the slip members in their innermost position, and retaining means at the upper end of the bowl acting to limit the upward movement of the slips within the bowl.

11. In combination with a pump polish rod, a rod hanger by which the polish rod is operatively connected to a pumping mechanism, said hanger including a housing, trunnions carried by the housing to provide support for the housing by the pumping means and to provide a horizontal pivot for the housing, a slip structure within the housing including a bowl mounted loosely within the housing, means supporting the bowl to permit the bowl to move laterally of the longitudinal axis of the housing while supported by the housing, slip members carried by the bowl to engage the pump polish rod and to cause it to move with the bowl, said slip members having longitudinally tapered back faces fitting into a correspondingly tapered seat in the bowl, means yieldably holding the slip members in their innermost position, retaining means at the upper end of the bowl acting to limit the upward movement of the slips within the bowl, and cooperating means between the housing and the retaining member acting to hold the bowl structure in its seated position while permitting relative lateral movement between the bowl structure and the housing.

12. In combination with a pump polish rod, a rod hanger by which the polish rod is operatively connected to a pumping mechanism, said hanger including a housing, trunnions carried by the housing to provide support for the housing by the pumping means and to provide a horizontal pivot for the housing, a slip structure within the housing including a bowl mounted loosely within the housing, means supporting the bowl to permit the bowl to move laterally of the longitudinal axis of the housing while supported by the housing, slip members carried by the bowl to engage the pump polish rod and to cause it to move with the bowl, said slip members having longitudinally tapered back faces fitting into a correspondingly tapered seat in the bowl, means yieldably holding the slip members in their innermost position, retaining means at the upper end of the bowl acting to limit the upward movement of the slips within the bowl, cooperating means between the housing and retaining member acting to hold the bowl structure in its seated position while permitting relative lateral movement between the bowl structure and the housing, and anti-friction means for supporting the bowl while permitting its free rotation around its central axis.

ROBERT C. JOHNSTON.