June 17, 1930. E. E. STEVENSON 1,764,058

PUMP JACK

Filed June 8, 1927 3 Sheets-Sheet 1

Fig. 1.

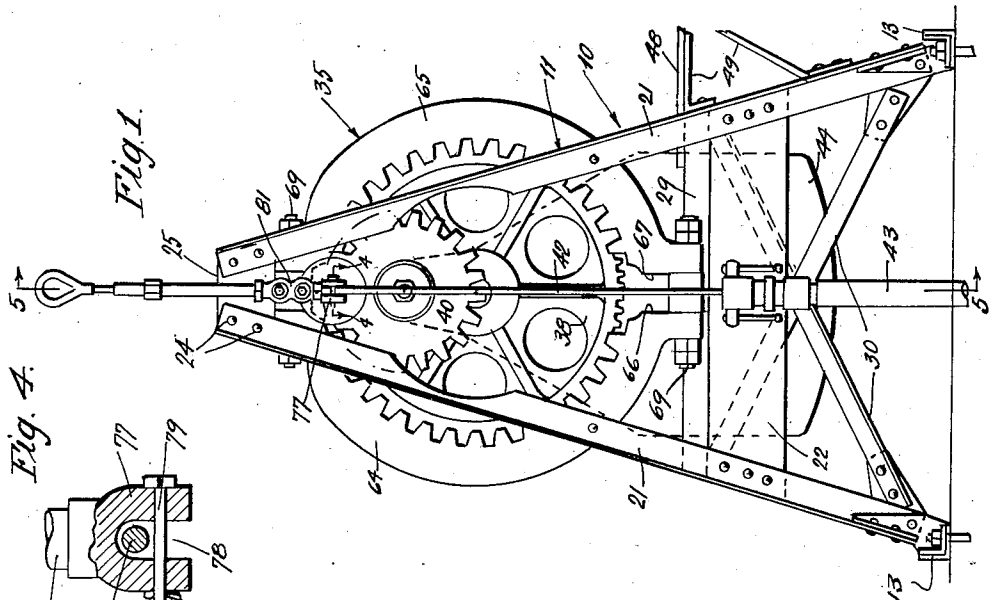


Fig. 4.

Fig. 2.

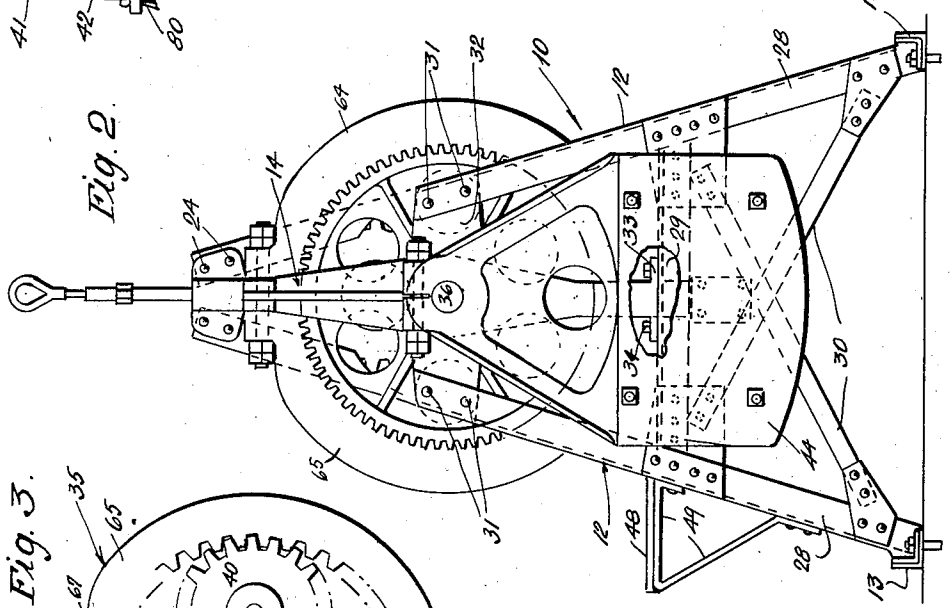
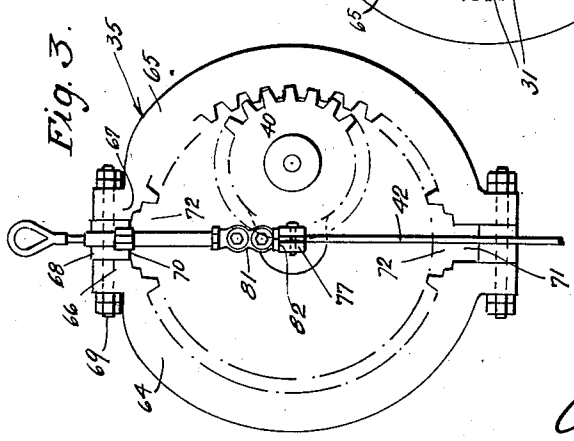


Fig. 3.



Inventor.
Edward E. Stevenson.

Attorney.

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Fig. 5.

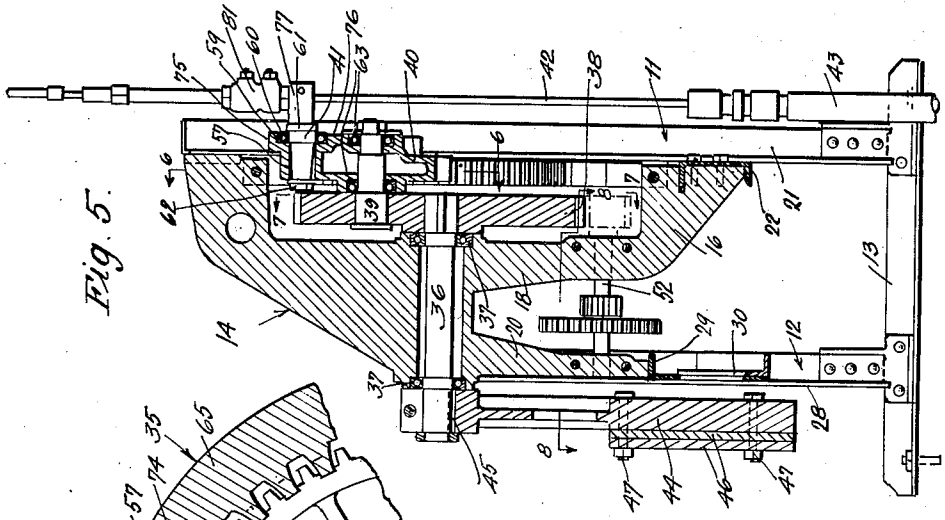


Fig. 6.

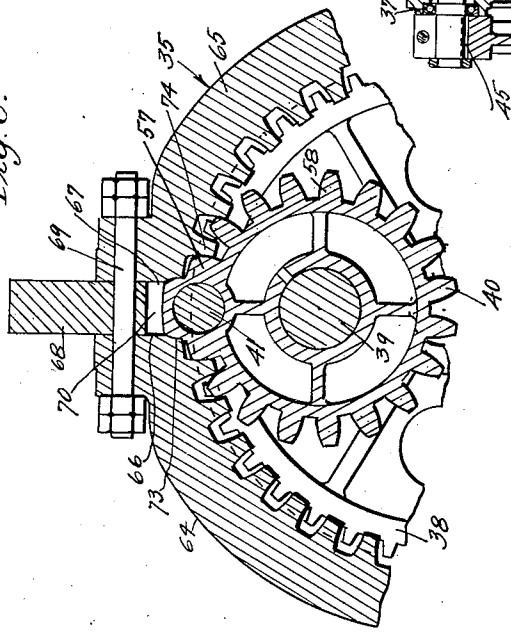


Fig. 7.

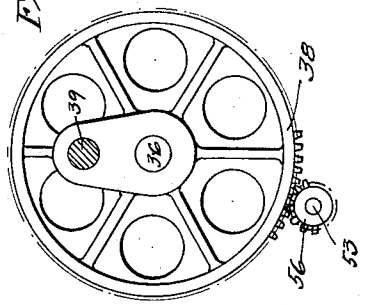
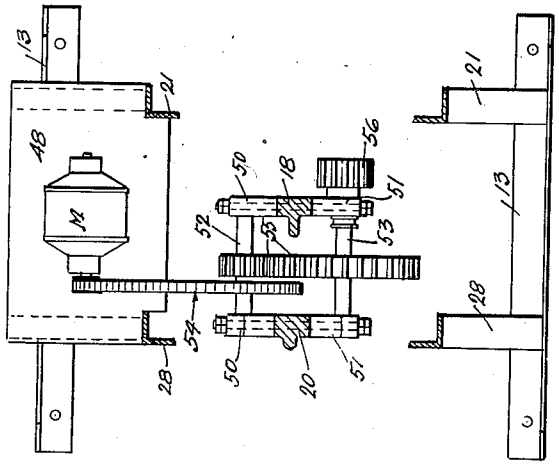


Fig. 8.



Inventor
Edward F. Stevenson.

Attorney.

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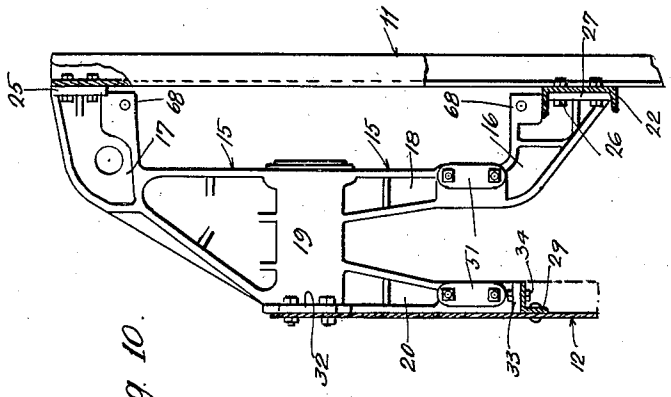


Fig. 10.

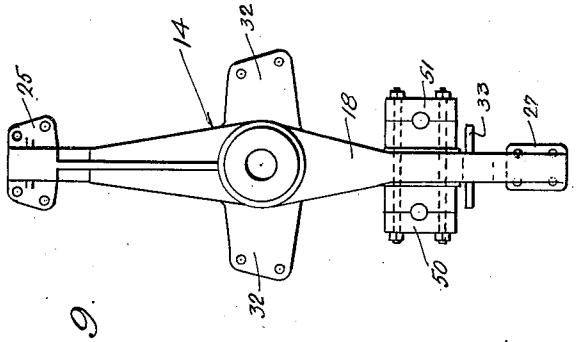


Fig. 9.

Inventor.
Edward. E. Stevenson

Attorney.

Patented June 17, 1930 1,764,058

UNITED STATES PATENT OFFICE

EDWARD E. STEVENSON, OF LOS ANGELES, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO EMSCO DERRICK & EQUIPMENT COMPANY, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA

PUMP JACK

Application filed June 8, 1927. Serial No. 197,364.

This invention relates generally to pump jacks or power heads such as are used for reciprocating deep well pumps of the plunger type, and more particularly concerns jacks or heads of the type wherein straight line reciprocatory movement is generated by the use of double cranks in association with planetary gearing.

In the patent issued to me October 19, 1926, No. 1,603,926, entitled Pumping jack, I have discussed generally the acknowledged superiority of this straight line or rectilinear movement type of head over the well-known walking beam pump jack, and pointed out some of the common weaknesses of usual straight line jacks. The jack here disclosed is of the general type shown in said patent, and has the same general advantages thereas. Additionally, it has features which render it superior in certain respects. These features may be pointed out best by a preliminary discussion of certain relative arrangements necessary to the operation of straight line jacks.

These jacks necessarily include a relatively stationary internal gear with a centrally disposed crank shaft carrying on its crank pin a planetary or travelling spur gear meshing with the internal gear. Adapted to be rotated by the spur gear is a secondary crank, the axis of rotation thereof being common with that of the spur gear, and the effective length of the crank being equal to the pitch radius of the spur gear. Then, with the spur gear half the size of the internal gear, the wrist pin of the secondary crank has straight line movement during planetation of the spur gear. It will be seen that with the secondary crank necessarily of the stated effective length, the axis of the wrist pin must intersect, either directly or by projection, the pitch circle of the spur gear, it following that the center of the wrist pin must come in line with the teeth of the spur gear. In order to provide sufficient supporting body for the wrist pin and to hold it in the given relationship with the spur gear, jacks of this type have either been provided with secondary cranks which are keyed to the shaft upon which the spur gear is non-rotatably mounted, thus holding the wrist pin in more or less spaced relation with the spur gear (such a situation being true in the device shown in the above-mentioned patent) or, the wrist pin has been mounted in an integral or attached extension on the spur gear, which extension is spaced from the teeth of the spur gear. Such a situation is shown in the patent to Woodward on Gearing for pumping jacks, No. 634,194, October 3, 1899.

In either of the above cases, it will be seen that the wrist pin support is necessarily transversely displaced from the spur gear, and consequently the rod-taking member on the wrist pin, which member is necessarily more greatly displaced from the spur gear than is the wrist pin support, considerably over-hangs the driving mechanism, or, expressed otherwise, the rod taken by the grip is necessarily at an appreciable horizontal distance from the spur gear.

With the tremendous load imposed on the pump rods by lifted columns of oil and the friction of the pump plunger within the pump barrel, it will be understood that it is highly desirable to have the connection between the pump rod and spur gear of the least effective length, that is, the pump rod should lie as close as possible to the vertical plane of the spur gear.

By my arrangement, the nearest approach to an ideal situation is attained, that is, the rod-taking member lies immediately adjacent the spur gear. This situation is brought about by mounting the wrist pin in one of the gear teeth, the axis of the pin intersecting the pitch circle at said tooth. It has always been recognized that such would be the ideal situation, but it has been considered impossible from a practical standpoint so to mount the wrist pin. This is for the reason that if the pin be of the requisite diameter, there is not normally sufficient stock in the gear tooth to support the pin properly, this particularly being true when it is desirable that the wrist pin be rotatably mounted, as in the present case. Merely to enlarge the

gear so its normal teeth are individually of a size to take a wrist pin, is not practical, for reasons which will be readily appreciated.

I have made it possible so to mount the wrist pin by enlarging one of the teeth, providing complementary tooth spaces in the internal gear to accommodate this enlarged tooth. The remainder of the teeth of the spur gear may be perfectly normal so the provision of the enlarged tooth in no way detracts from the general efficiency of the gearing. There are certain desirable, though not necessary, characteristics given to the enlarged tooth, but these may be discussed to better advantage in the following detailed description.

In accomplishing the above, I have also provided a structure having additional features of advantage as regards minimum number of working parts, facility of assembly, and maximum strength without unduly wracking the structure. I have also produced a structure which is advantageous due to features of space economy, a point of considerable importance.

Other features of novelty and objects of the invention will be made apparent in the following detailed description, reference being had to the accompanying drawings, in which:

Fig. 1 is a front elevation of an embodiment of my invention;

Fig. 2 is a rear elevation of the device, a portion of the counterbalance being broken away to expose underlying parts;

Fig. 3 is a fragmentary view, similar, in part, to Fig. 1, the spur gear having been planetated to a different position, and the supporting frame being omitted in order to expose underlying parts;

Fig. 4 is an enlarged section on line 4—4 of Fig. 1;

Fig. 5 is a section on line 5—5 of Fig. 1, certain parts being shown in elevation;

Fig. 6 is an enlarged, fragmentary section on line 6—6 of Fig. 5;

Fig. 7 is a fragmentary section on line 7—7 of Fig. 5;

Fig. 8 is a fragmentary section on line 8—8 of Fig. 5;

Fig. 9 is a detached, front elevation of the main casting of the pump jack; and

Fig. 10 is a side view of Fig. 9, showing also fragments of certain frame members which are secured to said casting.

I will first describe the supporting structure of the device with some particularity, though it will be understood that the invention, considered in its broader aspects, is not limited to the particularities of the showing.

The supporting member or frame generally indicated at 10 includes a forward, inverted V-shaped frame 11 and a rearward frame 12, the two frames being connected at their lower ends by skids 13, and near their upper ends by main casting 14. This main casting includes a vertically arranged yoke portion 15 (Fig. 10) consisting of spaced horizontal yoke arms 16, 17, and vertical cross bar 18. Extending rearwardly from bar 18 is a horizontal shaft-supporting portion 19 from the end of which depends a vertical leg 20.

Frame 11 consists of upwardly and inwardly inclining angle iron legs 21 which are tied together near their lower extremities to channel cross bar 22. The upper ends of legs 21 are bolted at 24 to transverse attachment ears 25 on arm 17, while arm 16 is centrally bolted to brace 22 at 26, arm 16 being provided with attachment ears 27 for this purpose.

Rear frame 12 is made up of upwardly and inwardly inclining legs 28 which are tied together by angle iron cross brace 29 and diagonal braces 30. Legs 28 are bolted at 31 to attachment ears 32 which extend transversely from the end of casting-portion 19, while leg 20 is provided with foot pieces 33 which rest on cross bar 29 and are bolted thereto at 34.

Without discussing in detail the novel peculiarities of the individual elements, I will now proceed to indicate generally the operating parts of the device. Thereafter, I will point out the novel peculiarities of the individual members whereby the desired end is reached, though it will be understood the particularities shown and mentioned are merely illustrative of and not limitative on the invention considered in its broader aspects.

An internal gear generally indicated at 35 is fixed to casting 15, and a crank shaft 36 is mounted in bearings 37 supported by casting portion 19, the gear and shaft being coaxial. A main crank, here shown in the form of driven gear 38, is keyed to shaft 36 and arranged at one side of internal gear 35. The crank gear 38 carries a crank pin 39 upon which is rotatably mounted a planetary spur gear 40 which is held in mesh with internal gear 35. Planetary spur gear 40 is exactly one-half the diameter of internal gear 35, and may be considered as a secondary crank since wrist pin 41 is connected directly thereto. The effective length of the secondary crank, that is, the center to center distance between crank pin 39 and wrist pin 41 is equal to the pitch radius of the spur gear, and therefore equal to one-half the pitch radius of internal gear 35. It follows that when gear 40 is caused to planetate, the wrist pin 41 has rectilinear movement, the arrangement here being such that this movement may be described as straight-line vertical reciprocation. It is believed unnecessary to trace the movement

of the wrist pin, as the principle of operation is an old one and well known to those skilled in the art. However, Fig. 3 illustrates one phase of the movement wherein crank shaft 36 has been rotated in a clockwise direction (as viewed in Fig. 1) to cause bodily movement or planetation of gear 40 through 90°. It will be noted that wrist pin 41 has moved constantly through the vertical axial plane of the crank shaft or, in other words, straight down.

Connection is made between wrist pin 41 and sucker or pump rod 42, which latter is adapted to be reciprocated through tubing 43 to operate a usual pump plunger (not shown) whereby vertical reciprocation of the wrist pin operates said rod and plunger, but the preferred nature of this connection will be described at a later point.

The spur gear 40 and its associated mechanism are counterbalanced by counterweight 44 which is keyed to crank-shaft 36 at 45. Preferably, the counterweight is of an adjustable nature, that is, one or more weight plates 46 may be detachably fixed to the weight proper by bolts 47 to vary the effectiveness of the counterbalance.

Crank shaft 36 may be rotated to operate the head through any suitable drive connection with any suitable power source. However, I have here shown a driving unit which is preferred due to its compactness and general efficiency, one of the features residing in the provision of an entirely self-contained power head.

An electric motor M is mounted on a shelf 48 supported by brackets 49 on legs 21 and 28. Mounted on opposite sides of casting bar 18 and casting leg 20 are the pairs of boxes 50 and 51, said box-pairs rotatably supporting counter-shafts 52 and 53, respectively. Shaft 52 is driven by motor M through a sprocket and chain drive generally indicated at 54 while shaft 53 is driven from shaft 52 through gear train 55. Crank gear 38 and crank shaft 36 are driven from shaft 53 through a pinion 56 on the last-named shaft and meshing with the teeth of crank gear 38.

With the general structure described above in mind, it will be apparent that the overhang of wrist pin 41 with respect to the plane of gears 40 and 35, should be held to a minimum, or in other words, the arrangement should be such that pump rod 42 should lie as close as possible to the side face of the spur and internal gears. The importance of this will be recognized when it is remembered that a tremendous load is placed upon the pump rods by the oil column within the tubing and above the pump plunger. With the wrist pin of such a length or so disposed that the point of rod application thereto is spaced appreciably from the spur gear, it will be realized that the wrist pin at its point of mounting, as well as the spur gear itself and its mounting, would be subjected to severe strains.

I have secured the ideal situation by mounting the wrist pin in one of the teeth of the spur pinion, it following that the pump rod may be brought into closest practical proximity with the spur gear. To accomplish this, I have provided gear 40 with an enlarged tooth 57 (Fig. 6) the enlargement being both as to thickness and radial extent with respect to a normal tooth 58 of said gear. The enlargement is preferably enough to provide for the rotational mounting of pin 41 in said tooth. Thus, in the present instance, I have shown tooth 57 as having a bore 59 in which is mounted ball or roller bearing 60, the pin being held from longitudinal displacement by collar 61 and retention nut 62 which are adapted to engage the spur gear at opposite sides thereof. It may be here noted, that preferably gear 40 is mounted through roller-bearing 63 for rotation upon crank pin 39.

Now the enlargement of tooth 57 is not controlled by the character of the other teeth of the spur gear, it merely being necessary to fashion the internal gear to receive the enlarged tooth properly. That is, it is not essential that the thickness of the enlarged tooth be a multiple of the thickness of any one of teeth 58. However, in order to simplify manufacture and secure best results as to strength of parts and efficient operation, it is preferable that the thickness of the enlarged tooth be a multiple of a standard or normal tooth 58. For instance, I have here illustrated tooth 57 as being five times as thick as a normal tooth, or the enlarged tooth may be considered as being made up, in part, by filling in the tooth spaces on each side of a given normal tooth. Also to simplify manufacture, especially with regard to the make-up of gear 35, the faces of the enlarged tooth are of stepped outline. That is, the dedendum of the enlarged tooth is equal to the working depth of the normal teeth, while the addendum portion of the tooth where it starts at the outside diameter of the spur gear, proper, is reduced in thickness. The stepped outline of the tooth faces thus includes a circumferential extent at each side and on the line of the outside diameter of the gear, proper, each of which extents is preferably substantially equal to a space between any two adjacent, normal teeth of the internal gear as measured at the roots of said normal teeth.

The addendum of the enlarged tooth need be extended radially only a sufficient distance to provide requisite body for supporting wrist pin 41.

Now it is necessary, of course, that internal gear 35 be fashioned with a pair of

diametrically opposed tooth recesses adapted to take enlarged tooth 57 as the spur gear travels through its planetary path. These recesses, which, of course, are substantially complementary to the enlarged tooth, may be provided by fashioning the internal gear in any suitable manner. However, I have shown a preferred construction of the internal gear and mounting therefor whereby the desired characteristics are given to it in a manner conducive to manufacturing facility.

Thus, gear 35 is made up of two substantially complementary segment-racks 64, 65, the ends 66 and 67 thereof being spaced apart by the spacer blocks 68 on the arms 16 and 17 of casting 15 (Figs. 9 and 10). Through-bolts 69 secure the segment racks in proper assembly with the main casting, it being understood that the segment racks are initially reduced in arcuate extent to compensate for the thickness of the spacer blocks so the internal gear, considered as a whole, is truly circular. The spaces 70 and 71 provided between the ends of the segment-racks by the interposition of the spacing blocks 68 provide enlarged gear spaces to take the addendum portion of enlarged tooth 57. The spacing of the opposed end teeth of the two segment racks provides enlarged gear spaces 72 to take the dedendum portion of the enlarged tooth 57. The side walls of recesses 70 and 71 may be relieved as at 73 to take the complementary faces of the addendum portion of the enlarged tooth. By properly proportioning tooth 57 as to thickness, it will be seen that whole, normal teeth, 74 may be provided on the opposed ends of the segment-racks, the advantage of this being self-evident.

In order that tooth 57 may provide longitudinal bearing of increased extent for pin 41, it may be built up somewhat as at 75 (Fig. 5) and there may be provided a boss portion 76 to take bearing 60, but these provisions are not essential to the invention, considered broadly, and the enlarged tooth may be considered as the sole support for the wrist pin.

While it lies within the scope of my invention to mount the wrist pin rigidly with a tooth of the spur gear, and to provide any suitable connection between said pin and pump rod 42, the rotational mounting of the pin is preferred, since the connection between the wrist pin and pump rod may then be of a very simple and particularly efficient nature. For instance, I have here shown the rod-taking member in the form of a fork 77 carried by wrist pin 41 (Fig. 4). Rod 42 is adapted to be taken in a vertically extending channel 78 of fork 77, a movable keeper or closure element preferably being provided to prevent accidental movement of the rod transversely out of the rod-taking channel 78. For instance, a keeper pin 79 may be thrust through the arms of the fork and across the mouth of channel 78, a cotter key 80 being adapted to hold the keeper pin detachably in mouth-closing position.

Clamped to rod 42 above fork 77 is any suitable type of collar or sleeve 81, this collar presenting a downwardly facing shoulder 82 adapted to rest on top the arms of the fork.

It will thus be seen that as the spur gear planetates through 180° from the position of Fig. 1, fork 77 is moved vertically downwardly to the end of its longitudinal stroke, the weight of the sucker rod line and fluid column above the pump plunger moving said rods downwardly at the same time, though the power head, through fork 77, controls the speed of rod descension.

As the spur gear continues in its planetation, fork 77 is vertically raised, and the sucker rods are thus moved through their work stroke. While this particular type of connection between the wrist pin and rods is not controlling on the invention, for it will be readily understood that any suitable grip may be substituted for the fork to connect the wrist pin and rod throughout operation of the power head, the above described type of connection is preferable both by reason of its simplicity and also for the reason that in the event the plunger becomes sanded in at the upper end of its stroke, the power head may continue in operation without an accompanying downward movement of the sucker rods. It will be readily understood that were the sucker rods to be forced downwardly by the wrist pin under such circumstances, there would be very apt to occur buckling or breaking of the sucker rods or power head elements.

The described connection between the rods and wrist pin or between the rods and spur gear may be characterized as one whereby gear planetation of given extent moves the rod longitudinally in one direction (that is, up) and allows planetation of said gear beyond the given extent without accompanying longitudinal movement of the rod. Such would be the case where the plunger becomes sanded in. That is, the gear would planetate to its uppermost position and thus positively move the rods upwardly and then continue in its planetation with fork 77 merely reciprocating idly with respect to the pump rod.

It will be understood the drawings and description are to be considered merely as illustrative of and not restrictive on the broader claims appended hereto, for various changes in design, structure and arrangement may be made without departing from the spirit and scope of said claims.

I claim:

1. In a device of the character described,

a supporting member, a pair of complementary segment-racks secured to the supporting member in complementary arrangement to form an internal gear and having their opposed ends spaced apart to provide tooth spaces of greater extent than the tooth spaces of the racks, and a spur pinion adapted to mesh with a travel about said gear and having an enlarged tooth adapted to enter said larger tooth spaces.

2. In a device of the character described, a stationary internal gear, a crank shaft disposed centrally of said gear, a main crank on said shaft, a planetating spur gear on the crank, the spur gear being in mesh with the internal gear and its diameter being one-half that of the internal gear, a wrist pin mounted at one end on the spur gear for rotation with respect thereto, a fork on the other end of the pin, and a member movable to and from a position to close the mouth of the fork slot.

3. In a device of the character described, the combination of: a stationary internal gear; a crank shaft disposed centrally of said internal gear; a main crank on said crank shaft; a planetating spur gear on said crank, said spur gear meshing with said internal gear, and said spur gear having an opening whose axis intersects the pitch diameter of said spur gear; a wrist pin extending into said opening; an annular boss formed on said spur gear around said opening; a bearing retained by said boss, and journalling said wrist pin; a rod adapted to be operated by said wrist pin; and a rod-taking members engaging the outer part of said wrist pin for holding said rod and said wrist pin relatively non-rotatable.

In witness that I claim the foregoing I have hereunto subscribed my name this 12th day of May, 1927.

EDWARD E. STEVENSON.