Aug. 22, 1939. R. E. WHITTLESEY 2,170,313

PUMP JACK

Filed Aug. 8, 1938 4 Sheets-Sheet 1

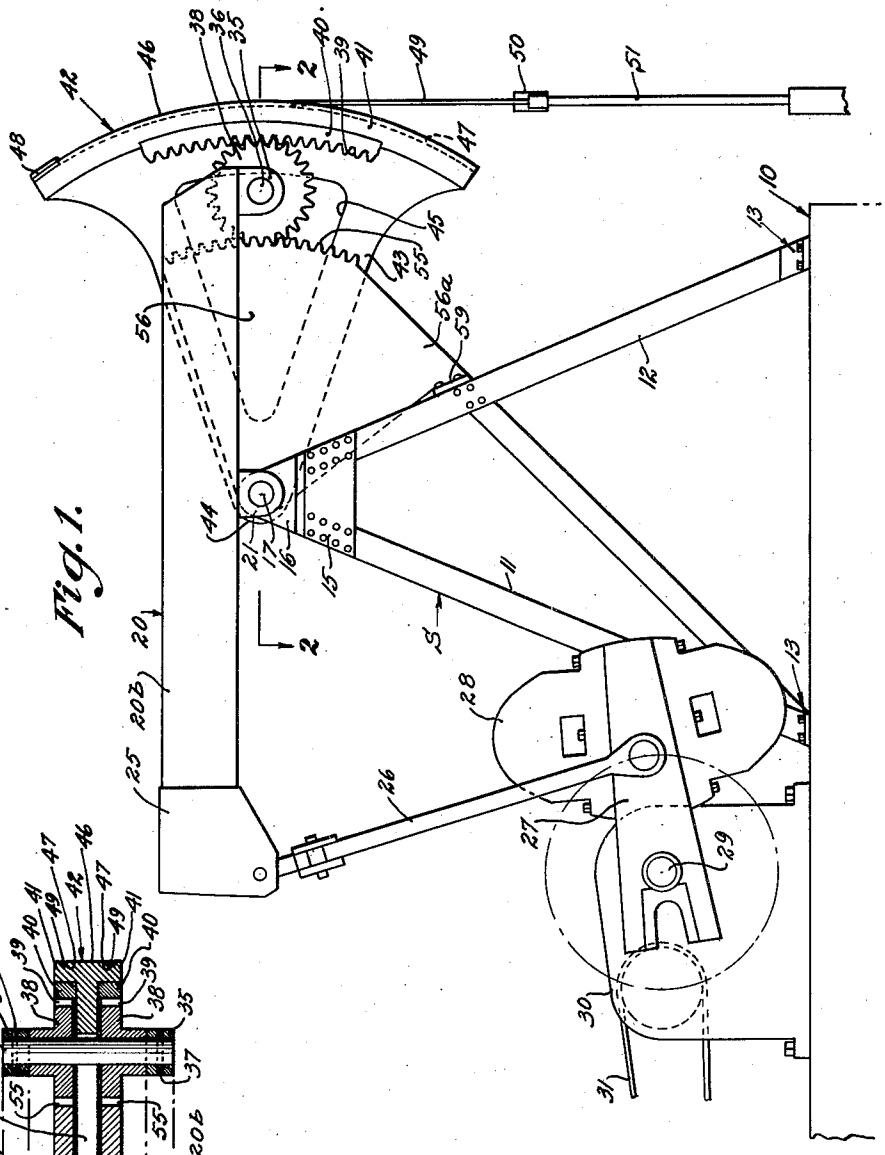


Fig. 1.

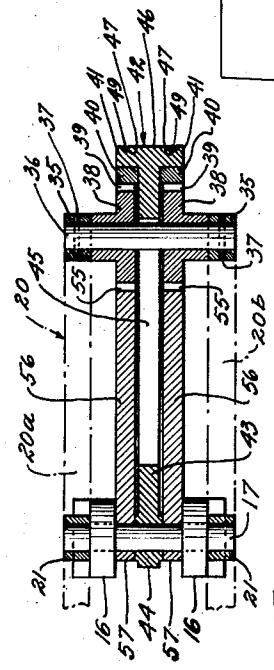


Fig. 2.

Inventor.
Ralph E. Whittlesey.

Attorney.

Aug. 22, 1939. R. E. WHITTLESEY 2,170,313

PUMP JACK

Filed Aug. 8, 1938 4 Sheets-Sheet 2

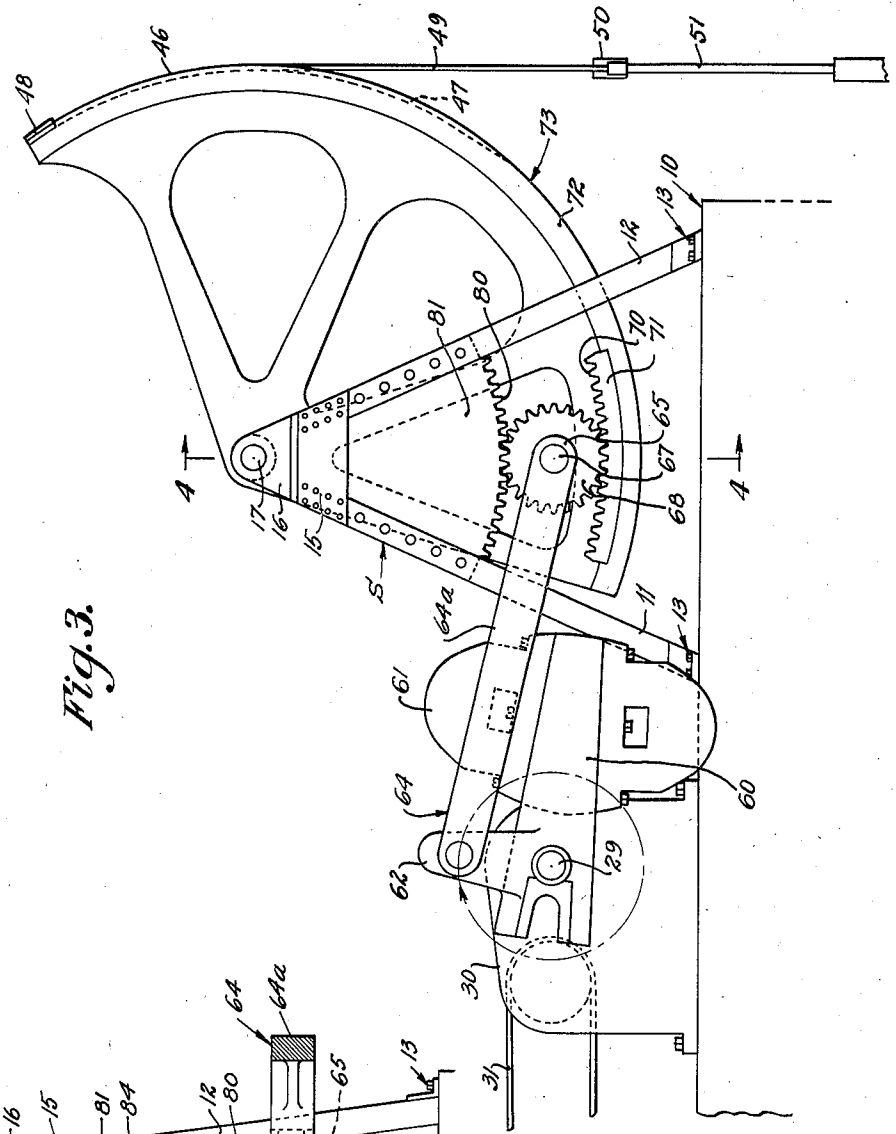


Fig. 3.

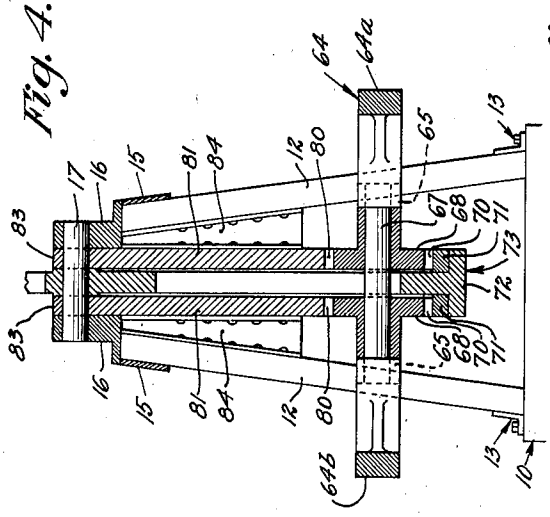


Fig. 4.

Inventor.
Ralph E. Whittlesey.

Attorney.

Aug. 22, 1939. R. E. WHITTLESEY 2,170,313

PUMP JACK

Filed Aug. 8, 1938 4 Sheets-Sheet 3

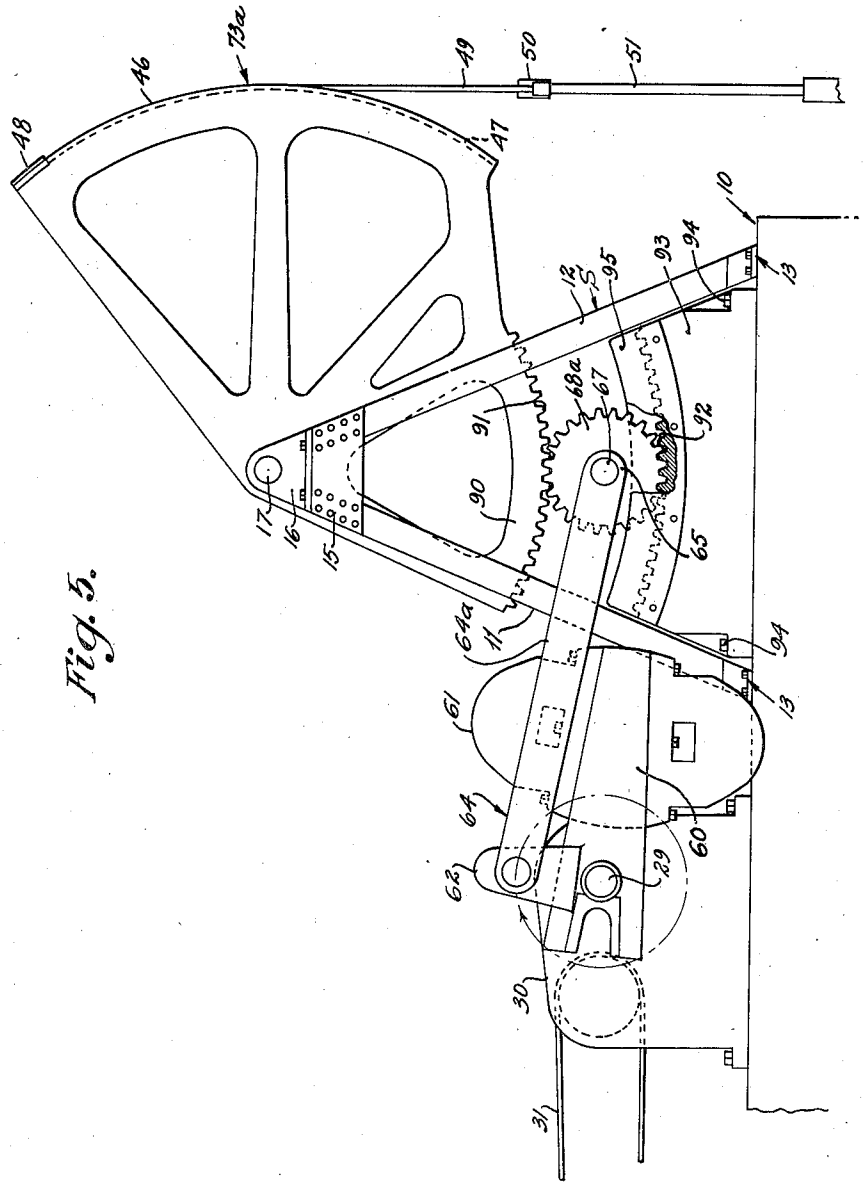


Fig. 5.

Inventor:
Ralph E. Whittlesey.

Attorney.

Aug. 22, 1939. R. E. WHITTLESEY 2,170,313

PUMP JACK

Filed Aug. 8, 1938 4 Sheets-Sheet 4

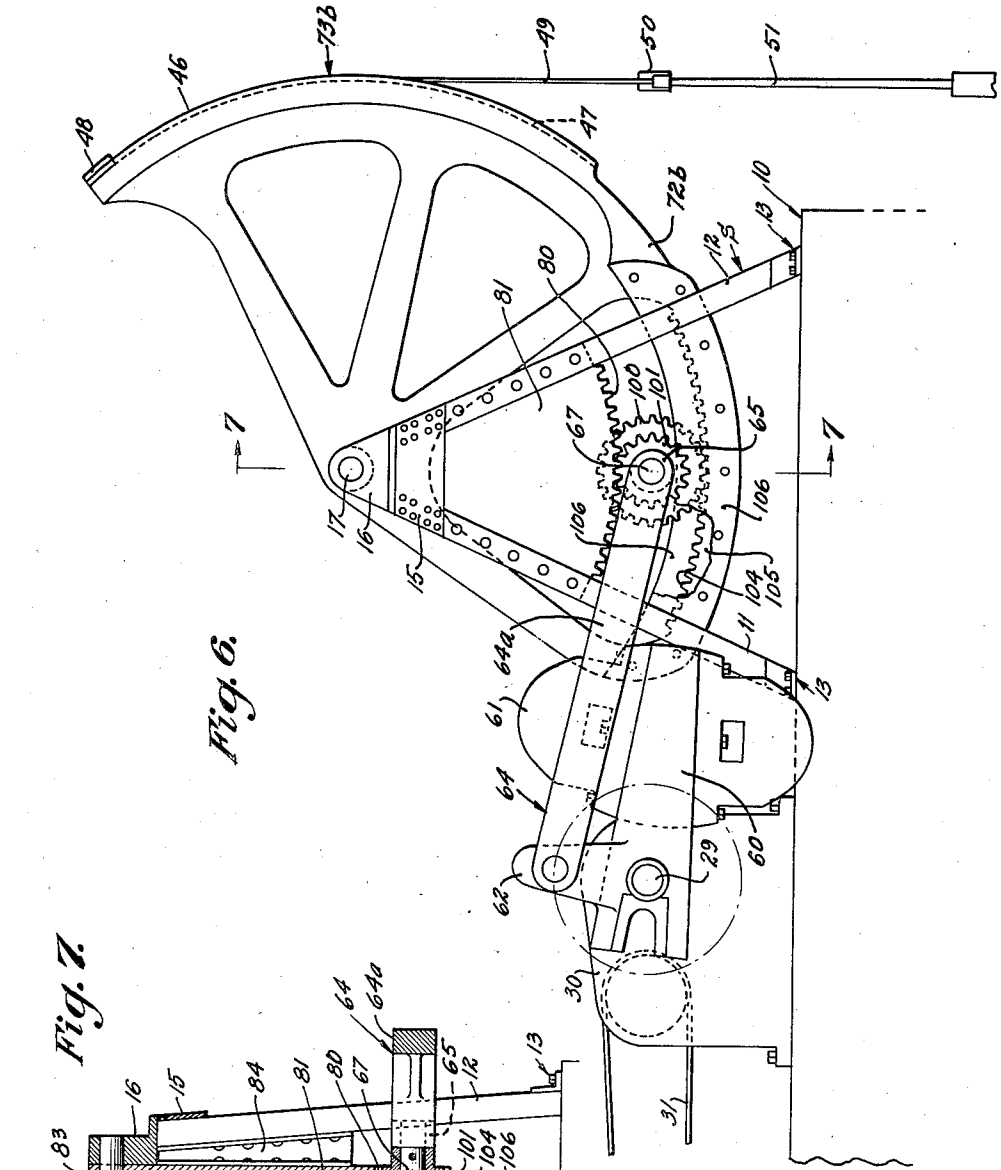


Fig. 6.

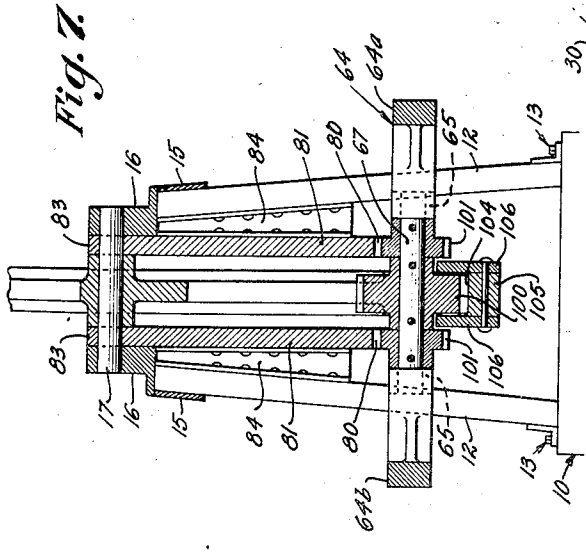


Fig. 7.

Inventor.
Ralph E. Whittlesey.

Attorney.

Patented Aug. 22, 1939 2,170,313

UNITED STATES PATENT OFFICE

2,170,313

PUMP JACK

Ralph E. Whittlesey, Los Angeles, Calif.

Application August 8, 1938, Serial No. 223,580

19 Claims. (Cl. 74—41)

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 a type wherein gearing is employed to increase or multiply the length of the stroke imparted to the pump string.

The desirability of a long pumping stroke, as well as the difficulty of accomplishing a long pumping stroke when using the ordinary walking beam type of jack, are too well known to warrant discussion here. It will suffice to point out that despite the relatively short stroke to which the conventional walking beam type of jack is inherently limited, and the general recognition of this shortcoming of the conventional walking beam, nevertheless this type of equipment remains to date as the standard of the industry. This condition is due mainly to lack of a simple, rugged, mechanical means, capable of being manufactured at a reasonable cost, for producing a substantially longer pumping stroke than is practicably obtainable with the usual simple walking beam jack.

It is accordingly a primary object of the present invention to provide a pump jack or head capable of generating a relatively long pumping stroke, yet one which is of comparatively simple construction, sturdily built, and capable of being manufactured at comparatively low cost.

A further object of the invention is to provide a compact pump jack capable of generating a comparatively long pumping stroke, without requiring either an excessively large stroke of the driving crank, or a pumping arm of excessive length.

The invention will be best understood by referring to the following detailed description of several typical forms which my invention may assume in practice, reference being made to the accompanying drawings, in which:

Fig. 1 is a side elevation of one form of pumping jack in accordance with my invention;

Fig. 2 is a section on line 2—2 of Fig. 1;

Fig. 3 is a side elevation of a modified pumping jack in accordance with the present invention;

Fig. 4 is a section on line 4—4 of Fig. 3;

Fig. 5 is a still further modified form of pumping jack in accordance with the invention;

Fig. 6 is a side elevation of a further modification; and

Fig. 7 is a section on line 7—7 of Fig. 6.

The present invention is capable of embodiment in a number of forms or arrangements; several of these will presently be described in some detail, though it is to be understood that this detailed description is merely illustrative of the broad invention rather than restrictive thereon, no intention being had to exhaust the various forms which the invention may assume in practice. With this understanding, I proceed to a detailed description of the specific form of my invention shown in Figs. 1 and 2.

A suitable foundation is indicated at 10, and this foundation may be of concrete or any suitable construction. The Samson post structure S comprises two pairs of legs 11 and 12, the lower ends of which are provided with suitable feet bolted to foundation 10, as indicated at 13, and the upper ends of which converge to an apex and are braced by side plates 15 riveted thereto.

Mounted on the upper ends of leg pairs 11 and 12 are bearings 16 for a horizontal shaft 17, and pivotally mounted on this shaft 17 is an oscillating beam 20, which may be regarded as corresponding to the walking beam of the usual pumping jack. As indicated in Fig. 2 of the drawings, this walking beam 20 may be made up of two parallel beams 20*a* and 20*b*, the lower side of each of which has, near its center, a depending hub 21 through which the aforementioned shaft 17 extends, the walking beam structure thus being pivotally mounted on shaft 17. The rearward ends of walking beam members 20*a* and 20*b* are interconnected by any suitable structure or head, as indicated at 25 in Fig. 1, and to this head 25 is pivotally connected the usual pitmans 26.

Pitmans 26 are driven by cranks 27 of usual type, having the usual counterweights 28. The drawings show only one pitman and one crank; it will be understood, however, that the other pitman and crank are just behind those illustrated, in accordance with present conventional practice. Or, of course, instead of using double cranks and pitmans, a single crank and pitman may be used, if desired. Cranks 27 are mounted on opposite ends of a drive shaft 29, which is rotated by suitable gear mechanism encased within housing 30 mounted on foundation 10, said gear mechanism being driven from the primary source of power, not illustrated, through driving belt 31.

The forward ends of walking beam members 20*a* and 20*b* have downwardly extending lugs 35 in which are mounted a gear axle 36, the latter being secured against displacement as by means of pins 37 (Fig. 2).

Rotatably mounted on axle 36, inside walking beam lugs 35, is a pair of spaced pinions 38,

here in the form of spur gears. These gears 38 mush with and are adapted to roll along certain hereafter described stationary gear members which act as reaction means, and also with certain other gear members which are operatively associated or connected with an oscillating sector head or sector-shaped pumping beam 42 pivotally mounted on shaft 17. Preferably, though this is not essential to the invention considered in its boader aspects, these last mentioned gears are mounted directly on sector head 42. Thus, as here illustratively shown, the forward sides of gears 38 mesh with internal gear teeth 39 on arcuate gear members 40 mounted on T-flanges 41 formed on oscillating sector head or sector-shaped pumping beam 42. This sector head 42 has a flange or web 43 extending rearwardly, between gears 38, to a hub 44 rotatably mounted on shaft 17, web 43 having an opening 45 affording clearance for shaft 36.

Head 42 is here indicated as having the usual arcuate face 46, formed with parallel cable receiving grooves 47, and provided at the top with a conventional means 48 for attachment or support of a usual cable 49 carrying the rod suspension means 50. Cable supporting means 48, as well as rod suspension means 50, may be of any suitable or conventional type, and the details thereof are accordingly not illustrated. Suspension means 50 is shown as supporting the polished rod 51 of the pump string.

The inner sides of spur gears 38 mesh with gear teeth 55 on stationary gear sectors 56, which are apertured at 57 to pass shaft 17. Gear sectors 56 are further supported by means of downwardly extending portions 56*a* which are provided with flanges 59 riveted to Samson post legs 12. Stationary gear sectors 56 are thus positioned between the web 43 of oscillating sector head 42 and bearings 16 for pivot shaft 17 (see Fig. 2).

The internal gear teeth on oscillating sector head 42 and the external gear teeth on stationary sectors 56 are concentric with reference to the axis of shaft 17, and gears 38 placed therebetween may be regarded as planetary gears. In operation, these planetary gears are oscillated by walking beam 20 (driven in the usual way from crank 27), being caused to travel an arcuate path concentric with the axis of shaft 17, and therefore to roll on stationary gear sectors 56, which act as reaction members causing gears 38 to rotate on their axis. In such action, the outer sides of gears 38, in mesh with the gear teeth on sector head 42, cause the later to be moved in the same direction as the walking beam, but through approximately twice the angular travel of the walking beam. With the radius of the sector teeth 39 greater than the radius of the sector teeth 55, the travel of the oscillating sector head approaches but does not quite equal twice the travel of the walking beam. It will be evident that the smaller the diameter of the planetary gears, and the greater the radii of the gear sectors, the nearer will the ratio of walking beam travel to oscillating sector-head travel approach one to two. In practice, the radius of the oscillating sector head is limited by factors of the same type that limit the length of the forward or pumping arm of a simple walking beam; and planetary gears 38 must be of sufficient size for strength as well as proper leverage. However, a design in which the radius of the sector head is of approximately the length of the pumping arm of a usual walking beam, with planetary gears of such relative size as is indicated in the drawings, produces an angular movement of the sector head which is nearly twice the movement of the walking beam. The pumping stroke is there multiplied by nearly two, without increase in the length of the oscillating pumping arm.

Figs. 3 and 4 show a modification, in which the walking beam is eliminated, the pitmans being directly connected to the axle of the planetary gears. In the embodiment of the invention shown in Figs. 3 and 4, the Samson post structure and driving gear box may be substantially the same as previously described in connection with Fig. 1, and for convenience corresponding members of the two embodiments are identified by the same reference numerals.

Drive shaft 29 of gear unit 30 has mounted thereon arms 60 having counterweights 61, and extending from each arm 60, at right angles to the direction of the latter, is a second arm 62. This arm 62, which is radial with reference to drive shaft 29, is the driving or crank arm, arm 60 being employed to carry counterweights 61 in a position 90° removed from arm 62. Pivotally connected to the two crank arms 62 are forwardly reaching connecting rods or pitmans 64*a* and 64*b*. Forwardly of rearward Samson post leg 11, these rods 64*a* and 64*b* curve inwardly toward one another (see Fig. 4) and their forward end portions 65 receive and support an axle 67 for a pair of planetary gears 68.

The outer or lower sides of gears 68 mesh with internal gear teeth 70 on arcuate gear members 71 mounted on T-flanges 72 of an oscillating sector head or sector-shaped pumping beam 73. Sector head 73 is pivotally mounted on shaft 17 supported by Samson post structiure S, in the manner described in connection with Fig. 1. It will be evident that sector head 73 of Figs. 3 and 4 corresponds generally to sector head 42 of Figs. 1 and 2, the sector head of the form of Figs. 3 and 4 differing from that of Figs. 1 and 2 only in that it is extended downwardly and rearwardly sufficiently to accommodate the position of planetary gears 68 carried by the described connecting rods 64*a* and 64*b*. The upper, or inner, sides of planetary gears 68 mesh with gear teeth 80 of stationary gear sectors 81, the latter being perforated at the top to pass shaft 17, as at 83. Flanged plates 84 riveted to sectors 81 and to Samson post legs 11 and 12 support said sectors in a stationary position.

In operation, connecting rods 64*a* and 64*b* driven by crank arms 62 effect oscillatory movement of planetary gears 68 along stationary gear sectors 81, and the action of planetary gears 68 on gear members 71 carried by sector head 73 is to oscillate the latter through an angle substantially double the angle travelled by gears 68, angular travel being understood to be referred to the axis of shaft 17. It will be evident that the action is equivalent to that obtained in the form of Figs. 1 and 2, the only difference being that the planetary gears are carried directly by the connecting rods, with the walking beam 20 of Fig. 1 eliminated. As with the form of Figs. 1 and 2, a long pumping stroke is obtained with a compact mechanism having a comparatively short oscillating pumping beam.

Attention is here called to the fact that, in the form of the invention shown in Figs. 3 and 4, the counterweights 61 must be 90° removed from the crank arms 62 in order to properly counterbalance the pump string.

In the embodiments of the invention so far described, the angular travel of the pumping

beam or head is slightly under twice the angular travel of the planetary gears. Fig. 5 shows an embodiment of the invention in which the angular travel of the oscillating pumping beam or head is somewhat greater than twice the angular travel of the planetary gears. The embodiment of Fig. 5 is in many respects similar to the embodiment of Figs. 3 and 4, and corresponding members are accordingly identified by the same reference numerals.

In the form of the invention shown in Fig. 5, an illustrative arrangement is shown in which a single planetary gear is used, with the stationary gear meshing with its lower or outer side, and the oscillating gear sector meshing with its inner or upper side. Thus, in the embodiment illustrated in Fig. 5, sector head 73*a* has a gear sector 90 having external gear teeth 91 meshing with the upper or inner side of planetary gear 68*a*, while the lower or outer side of said planetary gear meshes with internal gear teeth 92 on a gear member 93, which is mounted directly on base 10, as by means of bolts 94. Flanges 95 secured to the sides of gear member 93 confine planetary gear 68 against lateral displacement. The radius of sector head 73*a* is such that at the lower end of its stroke, it may travel in between flanges 95, above stationary gear 92.

In operation, planetary gear 68 is oscillated by the described crank and connecting rods, being caused to roll on stationary internal gear teeth 92. Gear 68*a* in so rolling on internal gear teeth 92 drives gear sector 90 of oscillating pumping beam or head 73*a*, causing the latter to travel through somewhat greater than twice the angular displacement of gear 68. Features of advantage in the form of Fig. 5 include increase in the travel of the oscillating sector head, and possibility of use of a single rather than a double set of gears.

Figs. 6 and 7 show a further modification, in which the planetary gear comprises two gear members of different radii. The form of the apparatus chosen for illustration of this further modification is generally similar to that shown in Figs. 3 and 4, and corresponding parts are accordingly identified by the same numerals. The apparatus of Figs. 6 and 7 may be regarded as the same as that of Figs. 3 and 4, excepting only for modification of the planetary gear means, the gear mounting on the oscillating sector head, and the spacing of the members parallel to axle shaft 17 (compare Figs. 4 and 7).

Thus, in the form of the invention shown in Figs. 6 and 7, the planetary gear means consists of a spur gear 100 mounted at the center of axle 67, and two smaller gears 101 mounted on opposite sides of gear 100 on axle 67. Gears 100 and 101 are all tight with one another, being indicated as pinned on axle 67. Smaller gears 101 mesh with external gear teeth 80 on stationary gear sectors 81, while large gear 100 meshes with internal gear teeth 104 formed on an internal gear 105 mounted between and secured to arcuate supporting plates 106 fastened to flanges 72*b* formed at the periphery of sector head 73*b*. Internal gear 105 is thus tightly mounted on the lower portion of oscillating sector head 73*b*, which latter is of the same general type as sector head 73 of Fig. 3, differing only in the provision for mounting internal gear 105 in a central position, so as to mesh with centrally located planetary gear 100.

The operation of the apparatus of Figs. 6 and 7 is as follows. Pitmans 64*a* and 64*b* carrying planetary gear axle 67 cause small planetary gears 101 to roll on stationary gear sectors 81. This action causes large planetary gear 100 to drive oscillating sector head 73*b* through internal gear 105 mounted on the latter. Because of the difference in radii of planetary gear members 100 and 101—gear 100 meshing with the gear on the oscillating sector head being larger than gears 101 in mesh with stationary gear sector 81—the angular travel or arc of swing of sector head 73*b* is increased, thus further increasing the length of the pumping stroke. The amount of this increase in travel of course depends upon the difference between the radii of gears 100 and 101, the greater the difference, the greater being the increase in length of stroke.

It will of course be understood that the type of planetary gear means shown in Figs. 6 and 7 is adaptable to any of the immediately described forms of the invention.

It will be evident, from the foregoing description of several typical embodiments of my invention, that the invention provides a compact pumping jack, characterized by exceptionally long stroke without increase in the length of the oscillating pumping beam or head, and characterized also by exceptional simplicity, sturdiness of construction, and low cost of manufacture.

While I have now described several typical embodiments of my invention, it is to be understood that these are for illustrative purposes only, and are not to be regarded as limitative on the invention, since various changes in design, structure and arrangement may be made without departing from the broad scope of the invention or of the appended claims.

I claim:

1. A pump jack embodying an oscillating pumping beam to which a pump string may be attached, a gear arranged to impart oscillating movement to said pumping beam, a reaction gear, intermediate gear means meshing with both said gears, and means for effecting reciprocative translation of said last mentioned gear means along said reaction gear.

2. A pump jack embodying an oscillating pumping beam to which a pump string may be attached, a gear arranged to impart oscillating movement to said pumping beam, a stationary reaction gear, interemdiate gear means meshing with both said gears, and means for effecting reciprocative translation of said last mentioned gear means along said reaction gear.

3. A pump jack embodying an oscillating pumping beam to which a pump string may be attached, a gear arranged to impart oscillating movement to said pumping beam, a reaction gear, an intermediate gear meshing with both said gears, and means including a crank and connecting rod for effecting reciprocative translation of said last mentioned gear along said reaction gear.

4. A pump jack embodying an oscillating pumping beam to which a pump string may be attached, a gear arranged to impart oscillating movement to said pumping beam, a reaction gear, an intermediate gear meshing with both said gears, and means including a crank and a connecting rod connected between said crank and said intermediate gear for effecting reciprocative translation of said last mentioned gear along said reaction gear.

5. A pump jack embodying a pumping beam arranged for oscillation about an axis, said pumping beam being adapted for support of a pump string, a gear on said pumping beam concentric

with said axis, a reaction gear of different radius concentric with said axis, a planetary gear in mesh with both said gears, and means for reciprocating said planetary gear along said reaction gear.

6. A pump jack embodying a pumping beam arranged for oscillation about an axis, said pumping beam being adapted for support of a pump string, a gear on said pumping beam concentric with said axis, a reaction gear of different radius concentric with said axis, planetary gear means comprising a pinion in mesh with said reaction gear, a second pinion concentric with said first mentioned pinion and fixed with relation thereto, said second pinion meshing with said gear on said pumping beam, and means for reciprocating said planetary gear means along said reaction gear.

7. A pump jack embodying a pumping beam arranged for oscillation about an axis, said pumping beam being adapted for support of a pump string, an internal gear on said pumping beam concentric with said axis, an external reaction gear of lesser radius concentric with said axis, a planetary gear in mesh with both said gears, and means for reciprocating said planetary gear along said reaction gear.

8. A pump jack embodying a pumping beam arranged for oscillation about an axis, said pumping beam being adapted for support of a pump string, an external gear on said pumping beam concentric with said axis, an internal reaction gear of greater radius concentric with said axis, a planetary gear in mesh with both said gears, and means for reciprocating said planetary gear along said reaction gear.

9. A pump jack embodying a pumping beam arranged for oscillation about an axis, said pumping beam being adapted for support of a pump string, a gear on said pumping beam concentric with said axis, a reaction gear of different radius concentric with said axis, a planetary gear in mesh with both said gears, and means for reciprocating said planetary gear along said reaction gear, including a power driven crank and connecting rod.

10. A pump jack embodying a pumping beam arranged for oscillation about an axis, said pumping beam being adapted for support of a pump string, a gear on said pumping beam concentric with said axis, a reaction gear of different radius concentric with said axis, a planetary gear in mesh with both said gears, and means for reciprocating said planetary gear along said reaction gear, including a walking beam pivotally mounted on said pumping beam axis, a power driven crank and connecting rod operatively connected with one arm of said walking beam, and said planetary gear being rotatably mounted on the other arm of said walking beam.

11. A pump jack embodying a pumping beam arranged for oscillation about an axis, said pumping beam being adapted for support of a pump string, an internal gear on said pumping beam concentric with said axis, an external reaction gear of lesser radius concentric with said axis, a planetary gear in mesh with both said gears, and means for reciprocating said planetary gear along said reaction gear, including a walking beam pivotally mounted on said pumping beam axis, a power driven crank and connecting rod operatively connected with one arm of said walking beam, and said planetary gear being rotatably mounted on the other arm of said walking beam.

12. A pump jack embodying a pumping beam arranged for oscillation about an axis, said pumping beam being adapted for support of a pump string, a gear on said pumping beam concentric with said axis, a reaction gear of different radius concentric with said axis, a planetary gear in mesh with both said gears, and means for reciprocating said planetary gear along said reaction gear, including a power driven crank, and a connecting rod connected between said crank and said planetary gear.

13. A pump jack embodying a pumping beam arranged for oscillation about an axis, said pumping beam being adapted for support of a pump string, an internal gear on said pumping beam concentric with said axis, an external reaction gear of lesser radius concentric with said axis, a planetary gear in mesh with both said gears, and means for reciprocating said planetary gear along said reaction gear, including a power driven crank, and a connecting rod connected between said crank and said planetary gear.

14. A pump jack embodying a pumping beam arranged for oscillation about an axis, said pumping beam being adapted for support of a pump string, an external gear on said pumping beam concentric with said axis, an internal reaction gear of greater radius concentric with said axis, a planetary gear in mesh with both said gears, and means for reciprocating said planetary gear along said reaction gear, including a power driven crank, and a connecting rod connected between said crank and said planetary gear.

15. A pumping jack embodying a Samson post, a sector head pivotally mounted on said Samson post, an oscillating walking beam pivotally mounted on said Samson post coaxially with said sector head, a gear on said sector head concentric with the pivot axis of said head, a stationary gear concentric with said pivot axis but of a radius different from the radius of said first mentioned gear, a planetary gear rotatably mounted on one arm of said walking beam and positioned between and in mesh with said two concentric gears, and means connected with the other arm of said walking beam for oscillating the walking beam.

16. A pumping jack embodying a Samson post, a sector head pivotally mounted on said Samson post, an oscillating walking beam pivotally mounted on said Samson post coaxially with said sector head, an internal gear on said sector head concentric with the first axis of said head, a stationary external gear concentric with said pivot axis but of radius lesser than the radius of said internal gear, a planetary gear rotatably mounted on one arm of said walking beam and positioned between and in mesh with said two concentric gears, and means connected with the other arm of said walking beam for oscillating the walking beam.

17. A pumping jack embodying a Samson post, a sector head pivotally mounted on said Samson post, a gear on said sector head concentric with the pivot axis of said head, a stationary gear concentric with said pivot axis but of a radius different from the radius of said first mentioned gear, a planetary gear positioned between and in mesh with said two concentric gears, an axle for said planetary gear, a power driven crank, and a connecting rod connected between said crank and the axle for said planetary gear.

18. A pumping jack embodying a Samson post, a sector head pivotally mounted on said Samson post, an internal gear on said sector head concentric with the pivot axis of said head, a sta-

tionary external gear concentric with said pivot axis but of a radius less than the radius of said internal gear, a planetary gear positioned between and in mesh with said two concentric gears, an axle for said planetary gear, a power driven crank, and a connecting rod connected between said crank and the axle for said planetary gear.

19. A pumping jack embodying a Samson post, a sector head pivotally mounted on said Samson post, an external gear on said sector head concentric with the pivot axis of said head, a stationary internal gear concentric with said pivot axis but of a radius greater than the radius of said external gear, a planetary gear positioned between and in mesh with said two concentric gears, an axle for said planetary gear, a power driven crank, and a connecting rod connected between said crank and the axle for said planetary gear.

RALPH E. WHITTLESEY.