April 5, 1938. A. N. PORTER 2,113,281

STRAIGHT LIFT PUMPING UNIT

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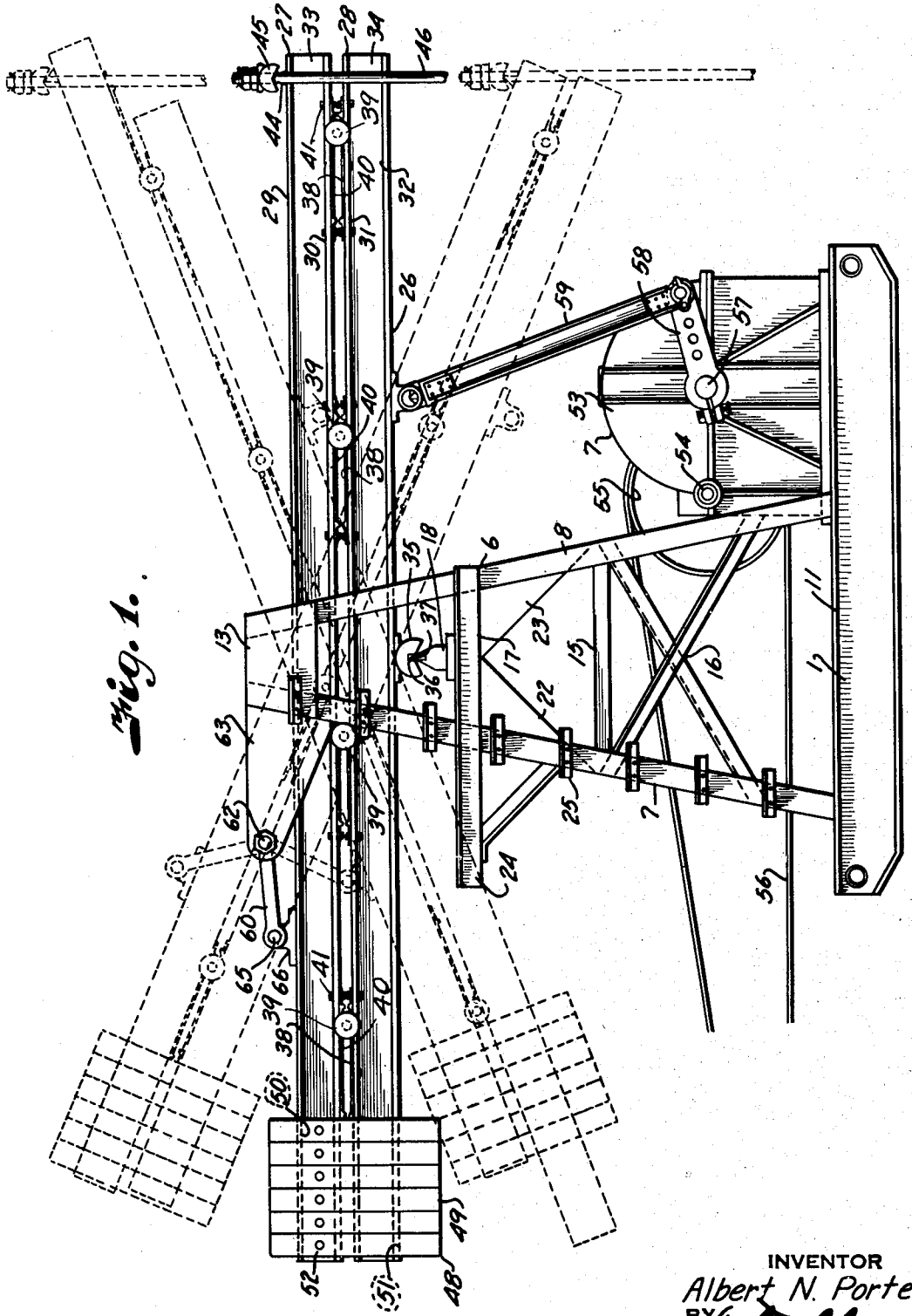

Fig. 1.

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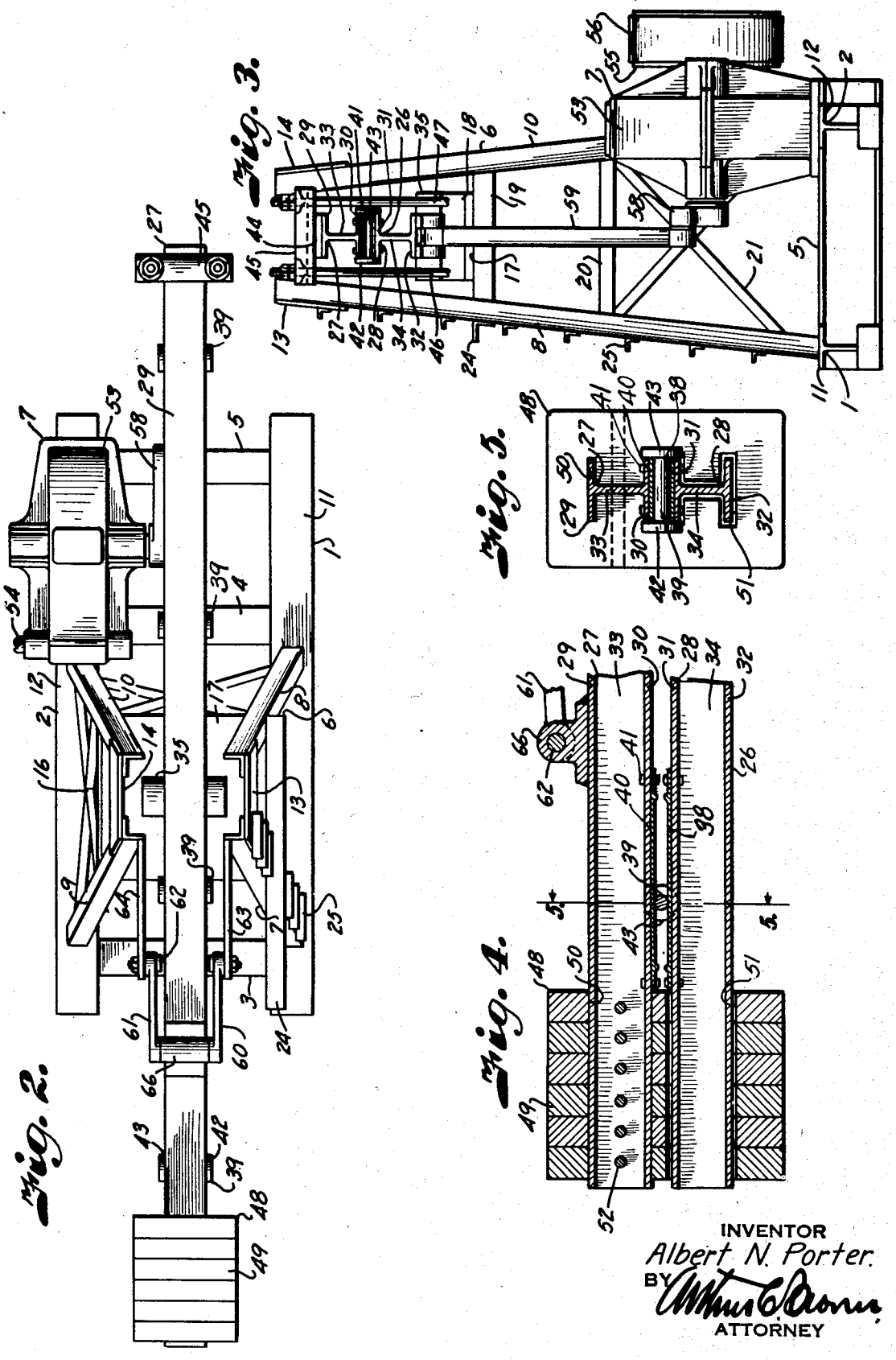

Fig. 2.

Fig. 3.

Fig. 5.

Fig. 4.

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Fig. 7.

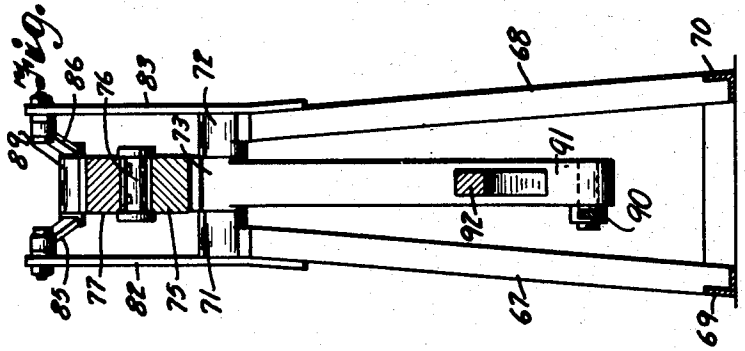


Fig. 6.

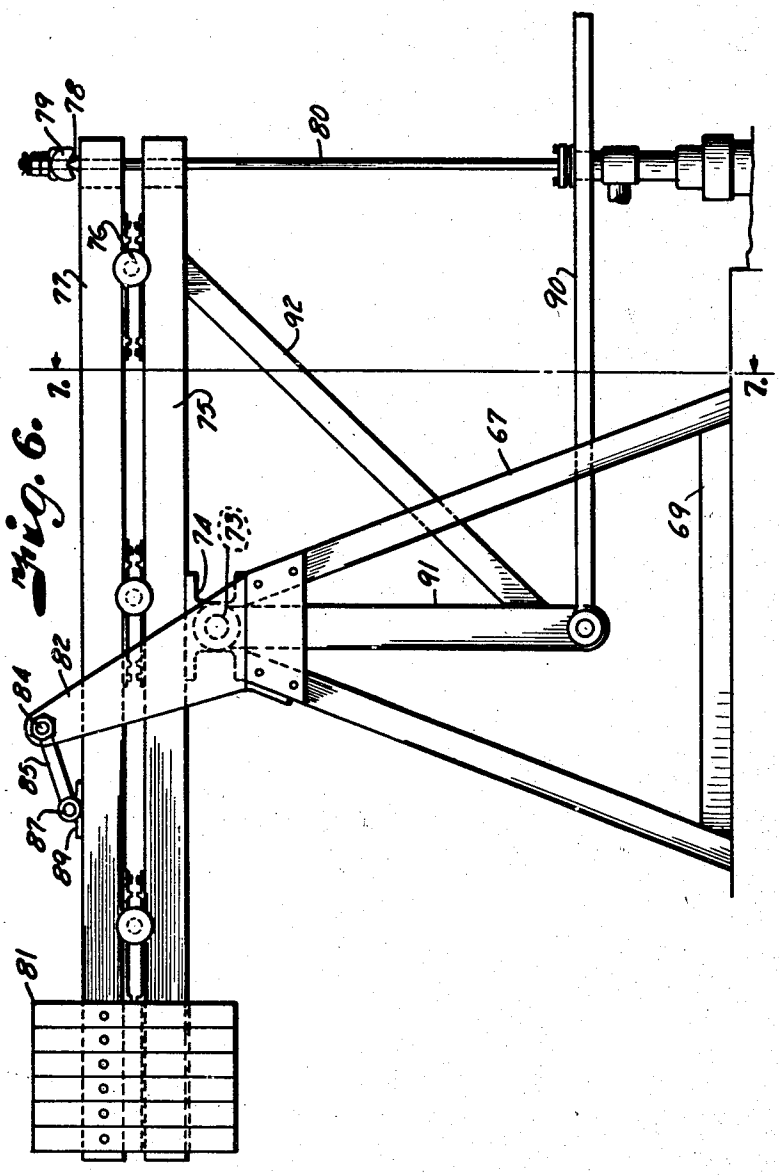
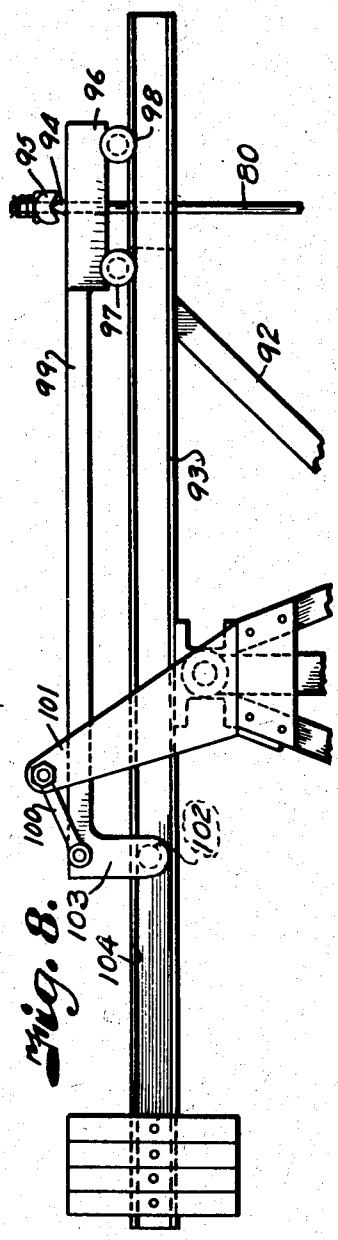


Fig. 8.



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Patented Apr. 5, 1938

2,113,281

UNITED STATES PATENT OFFICE

2,113,281

STRAIGHT LIFT PUMPING UNIT

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Application May 1, 1937, Serial No. 140,219

12 Claims. (Cl. 74—103)

This invention relates to well pumping apparatus, particularly to those used for pumping oil wells, and has for its principal object to provide an apparatus of this character constructed to impart straight lift of the pumping rods.

Other important objects of the invention are to provide an improved beam structure that may be formed of standard structural members so related as to produce straight lift of the rods, and which have ample strength to withstand forces of the pumping load.

Other important objects of the invention are to provide a beam structure having a high strength weight ratio; and to reduce the cross-sectional size of the beam required in handling a given pumping load.

A further object of the invention is to provide the beam with counterweights tending to balance the weight of the pumping rods so as to facilitate the straight lift action applied to the rods.

In accomplishing these and other objects of the invention, as hereinafter pointed out, I have provided improved details of structure, the preferred forms of which are illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevational view of a pumping unit embodying the features of the present invention.

Fig. 2 is a plan view of the pumping unit.

Fig. 3 is a front elevational view of the pumping unit.

Fig. 4 is an enlarged section through the counter-balanced end of the beam.

Fig. 5 is a cross-section on the line 5—5 of Fig. 4.

Fig. 6 is a side elevational view of a pumping jack constructed in accordance with the present invention.

Fig. 7 is a vertical cross-section through the apparatus on the line 7—7 of Fig. 6.

Fig. 8 is a side elevational view of the upper portion of a further modified form of the invention.

Referring more in detail to the drawings, and first to the form of the invention illustrated in Figs. 1 to 5 inclusive:

1 and 2 designate spaced sills preferably of I-beam type and connected by cross members 3, 4 and 5 to form a skid-like base carrying a walking beam supporting structure 6 and a power transmission unit 7. The structure 6 includes pairs of corner legs 7—8 and 9—10, having their lower ends connectingly supported on the upper flanges 11 and 12 of the sills 1 and 2, adjacent the rear ends thereof, to leave space at their forward ends for mounting the transmission unit 7.

The legs 7—8 and 9—10 of each pair converge upwardly and inwardly and are connected at their upper ends by plates 13 and 14. The lower portions of the legs are further braced by girths 15 and cross braces 16 to enhance the rigidity thereof. The pairs of legs 7—8 and 9—10 converge toward each other and support a platform 17 that is spaced below the upper ends thereof to mount a fulcrum 18 on which the walking beam is pivotally mounted, as later described. The platform 17 includes cross girths 19 which cooperate with lower cross girths 20 and cross braces 21 to enhance the rigidity of the legs in a crosswise direction. The platform 17, which carries the fulcrum, is further braced by gusset plates 22 and 23 secured to the legs and to the under side of the platform. The pairs of legs 7 and 8 may be provided at the level of the platform with a walkway 24 that is reached by a ladder, consisting of cleats 25, secured to the leg 7.

Oscillatably mounted on the fulcrum member 18, and operable between the upper ends of the pairs of legs 7—8 and 9—10, is a walking beam 26 constructed to form an important part of the present invention. The beam 26 includes upper and lower sections 27 and 28 preferably formed of standard structural members, such as I-beams, having upper and lower flanges 29—30 and 31—32 and webs 33 and 34. In the illustrated instances, the beam sections are arranged with the flanges thereof extending horizontally and the webs vertically, as shown in Fig. 3. The flange 32 of the lower beam section is provided approximately midway of its length with a bearing member 35 that is pivotally supported on the fulcrum member 18. In the illustrated instance the fulcrum 18 is shown as provided with a knife edge bearing 36 that is engaged in a V shaped seat 37 of the bearing member 35, however, other types of bearings may be substituted without departing from the spirit of the invention. Fixed upon the upper flange 31 are spaced plates 38 forming tracks for rollers 39, as shown in Fig. 1, to mount the upper beam section 27. The lower flange 30 of the beam section 27 is also provided with plates 40 bearing upon the rollers whereby the upper section is mounted for rolling, reciprocatory movement on the lower section during oscillation of the beam, as later described. The plates 38 and 40 are preferably attached by bolts 41 to adapt them for ready removal and replacement in case of wear.

The ends of the rollers are preferably pro-

vided with flanges 42 and 43 that overlap the side edges of the plates 38 and 40 to retain the beam sections in vertical alignment so that the upper section reciprocates in a fixed path on the lower section. The forward end of the upper beam section carries a fulcrum member 44 for mounting a cross bar 45, having its ends projecting beyond the side edges of the beam section to carry reins 46 and 47 that are connected to a polish rod of a pumping string (not shown). The opposite end of the upper beam section carries a counterbalance 48 comprising a series of weights 49 having interconnected, substantially I-shaped openings 50 and 51 extending therethrough to accommodate the ends of the beam sections. The upper opening is of sufficient dimensions to closely fit the end of the upper beam section, but the lower opening is sufficiently large to loosely pass the lower beam section as best shown in Fig. 5. The weights 49 are secured in juxtaposition by means of cross bolts 52 extending through the weights and through the web 33 of the upper beam section, as shown in Figs. 1 and 5.

In the illustrated instance, the lower beam section is oscillated by the power of a prime mover (not shown), through the transmission mechanism 7. The transmission mechanism 7 includes a housing 53 that is mounted on the forward end of the sill 2 and carries suitable gearing that is actuated by a shaft 54 carrying a pulley 55 driven by a belt 56. The transmission unit 7 also includes a crank shaft 57, carrying a crank 58 that is operably connected with the lower beam section by means of a pitman 59, the pitman being connected with the beam section at a point ahead of its fulcruming point. The pitman and crank therefore tend to support the forward end of the beam.

In order to effect reciprocation of the upper beam on the lower beam section to maintain the fulcrum member 44 in perpendicular alignment with the polish rod, the upper beam section is provided with a control mechanism now to be described. The control mechanism includes spaced links 60 and 61 that are pivotally connected by bolts or the like 62 with bracket plates 63 and 64 projecting rearwardly from the legs 7 and 8, as best shown in Figs. 1 and 2. The opposite ends of the links are connected with a shaft 65 that is mounted in a bearing bracket 66 fixed transversely across the upper flange 29 of the beam section at a point rearwardly of the fulcrum. The length of the links 60 and the relative distances of the pivotal axis thereof from the fulcrum point of the beam are so related as to produce the desired reciprocatory movement of the upper beam section on the lower beam section to maintain a straight lift on the polish rod.

In the form of the invention illustrated in Figs. 6 and 7, 67 and 68 designate spaced frames that are supported by longitudinal sills 69 and 70. The upper ends of the frames are spaced apart to mount bearing members 71 and 72 to carry a cross shaft 73 to mount a saddle bearing 74 that supports the lower beam section 75, similar to the lower beam section in the first form of the invention.

Reciprocably mounted on the beam section 75, and bearing upon rollers 76, is the upper beam section 77 that carries a fulcrum 78 which mounts a cross head 79 to which the polish rod 80 is connected, as in standard practice. The opposite end of the beam section carries counterbalance weights 81, similar to the preferred form of the invention. Mounted on the upper ends of the frames 67 and 68 are brackets 82 and 83 which project above the upper beam section and carry a cross shaft 84 having links 85 and 86, corresponding to the control links in the first form of the invention. The opposite ends of the links are connected with a shaft 87 that is fixed in a bearing bracket 89 attached to the upper beam section. In this form of the invention the beam sections are actuated by a pull rod 90 that is connected with a depending arm 91 attached to the saddle 73 and braced from the lower beam section by an angular brace member 92.

The form of the invention illustrated in Fig. 8 shows a single beam 93 that is oscillatably supported in the same manner as the lower beam section 75 in the form of the invention illustrated in Figs. 6 and 7, and the fulcrum 94, which carries the polish rod cross head 95, is mounted on a carriage 96 rollingly supported on the beam by means of rollers 97 and 98. The carriage 96 is reciprocated on the beam incidental to oscillation thereof by means of an arm 99 that is connected thereto, and with links 100 that are pivoted to a bracket member 101, similar to the bracket members 82 in the form of the invention illustrated in Figs. 6 and 7. The arm 99 is kept in functional relation with the beam by rollers 102 that are secured to ears 103 depending downwardly along the sides of the beam so that the rollers engage under the upper beam flanges 104.

The operation of the pumping apparatus assembled as illustrated in Figs. 1 to 5, is as follows:

Rotation of the crank 58 causes oscillation of the lower beam section through the pitman 59. The upper beam section, being mounted on the lower beam section, oscillates therewith and reciprocates thereon incidental to its link connection with the brackets on the supporting frame. For example, as the forward ends of the beam sections swing upwardly and the rear ends downwardly, the links 60 and 61 swing downwardly in an arc about the axis of the bolts 62, so that the axis of the shaft 65 approaches the vertical plane extending through the first named axis, which causes rolling movement of the upper beam section on the lower beam section as shown by the dotted lines in Fig. 1, the linkage being such that the forward movement of the beam section is sufficient to maintain the polish rod in substantially perpendicular position. During this movement the counterweights are carried forwardly therewith, however, they slide loosely over the rear end of the lower beam section as shown by the dotted lines. When the beam sections have reached the top of their stroke and are caused to move downwardly as the crank 58 passes upper dead center, the control links swing upwardly to cause retractive movement of the upper beam section as shown by the upper dotted lines (Fig. 1), so as to retain the fulcrum point 44 of the anchor in perpendicular alignment with the axis of the polish rod.

The form of the invention illustrated in Figs. 6 and 7 operates in a similar manner, however, the walking beam is oscillated upon reciprocatory movement of the pull rod 90, as in conventional pumping jack structures.

In the form of the invention illustrated in Fig. 8, oscillation of the beam 93 causes reciprocatory movement of the carriage 96 thereon to maintain the fulcrum point 94 in perpendicular alignment with the rods during arcuate movement of the end of the beam.

From the foregoing it is apparent that I have provided a relatively simple pumping apparatus wherein a straight lift is imparted to the rods and the beam sections may be formed of standard structural shapes, one of the sections supplementing the other to impart the required rigidity.

What I claim and desire to secure by Letters Patent is:

1. A pumping rig including a support, a beam member, means mounting the beam member for oscillatory movement on the support, means for actuating the beam member, a reciprocatory member, means mounting the reciprocatory member for rolling support by the beam member, a polish rod hanger connected with said reciprocatory member, and means for reciprocating the reciprocatory member during oscillation of the beam member.

2. A pumping rig including a support, superimposed beam sections arranged on the support whereby the pumping loads are carried by both sections, means fulcruming one beam section on the support, means for oscillating the fulcrumed beam section, means mounting the other beam section for reciprocatory movement on the fulcrumed beam section, and means for reciprocating the reciprocatory beam section on the fulcrumed beam section incidental to oscillation of the fulcrumed beam section.

3. A pumping rig including a support, a beam member, means mounting the beam member for oscillatory movement on the support, means for actuating the beam member, a member mounted for reciprocatory movement on the beam member, a polish rod hanger having pivotal connection only with said reciprocatory member, and means for connecting the reciprocatory member with the support to effect reciprocation of said reciprocatory member incidental to oscillation of the beam member.

4. A pumping rig including a support, superimposed beam sections having substantially equal load bearing capacities, means fulcruming one of the beam sections on the support, means for oscillating the fulcrumed beam section, means mounting the other beam section for reciprocatory movement on the fulcrumed beam section, and means for reciprocating the reciprocatory beam section on the fulcrumed beam section incidental to oscillation of the fulcrumed beam section.

5. A pumping rig including a support, a beam comprising upper and lower beam sections, means fulcruming the lower beam section on the support, means mounting the other beam section for reciprocatory movement on the fulcrumed beam section, and a link mechanism connecting the reciprocatory beam section with the support to effect reciprocation thereof incidental to oscillation of the fulcrumed beam section.

6. A pumping rig including a support, a beam comprising upper and lower sections, means fulcruming the lower beam section on the support, means mounting the other beam section for reciprocatory movement on the fulcrumed beam section, a bracket on the support, a link pivotally connected with the bracket and having pivotal connection with the reciprocatory beam section, and means for oscillating the fulcrumed beam section to effect oscillatory and reciprocatory movement of said other beam section.

7. In a pumping rig, spaced pairs of supporting legs, a platform carried between the pairs of legs and spaced below the upper ends of said legs, a fulcrum member on the platform, a beam section pivoted on the fulcrum member, a beam section having rolling support on the fulcrumed beam section, brackets carried by the pairs of legs on opposite sides of the beam sections, links pivoted on the brackets, and means pivotally connecting the links with the beam section having said rolling support.

8. A pumping rig including a support, a beam comprising upper and lower beam sections, means fulcruming one of the beam sections on the support, means rollingly supporting the other beam section for reciprocation relatively to the fulcrumed beam section, a polish rod hanger carried by one end of the reciprocatory beam section, and a counter-weight connectingly supported by the opposite end of said beam section.

9. A pumping rig including a support, a beam member, means mounting the beam member for oscillatory movement on the support, means for oscillating the beam member rollers on the beam member, a member mounted on said rollers for reciprocatory movement on the beam member, a polish rod hanger connected with said reciprocatory member, and means connecting the reciprocatory member with the support to effect reciprocation of said reciprocatory member incidental to oscillation of the beam member.

10. A pumping rig including a support, a beam comprising upper and lower beam sections, means fulcruming one of the beam sections on the support, rollers on the fulcrumed beam section and carrying the other beam section for reciprocatory movement on the fulcrumed beam section, and a link mechanism connecting the reciprocatory beam section with the support to effect reciprocation thereof incidental to oscillation of the fulcrum beam section.

11. A pumping rig including a support, a beam comprising upper and lower beam sections, means fulcruming one of the beam sections on the support, rollers on the fulcrumed beam section and carrying the other beam section for reciprocatory movement on the fulcrumed beam section, wear plates fixed to the beam sections for contacting with the rollers, and a link mechanism connecting the reciprocatory beam section with the support to effect reciprocation thereof incidental to oscillation of the fulcrum beam section.

12. A pumping rig including a support, a beam section, means mounting the beam section for oscillatory movement on the support at a point intermediate its ends, a superimposed beam section, means mounting the respective ends of the superimposed beam section adjacent the corresponding ends of the oscillatory beam section, a polish rod hanger connected with the reciprocatory beam section, means for oscillating the oscillatory beam section, and means connected with the reciprocatory beam section for effecting reciprocatory movement of said beam section on the oscillatory beam section.

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