This invention relates to deep well pumping apparatus and particularly pertains to a pumping unit for operating deep well pumps.

It is the principal object of the present invention to provide a generally improved pumping unit for deep well pumps by means of which the well load may be fully counterbalanced so as to minimize the power expended in operating the pump.

In carrying out the invention into practice I provide a comparatively inexpensive pumping unit for pumping deep wells which can be set up at the well in a comparatively short period of time and which takes up but very little space. This is a considerable improvement over prior structures and methods which either entailed leaving the drilling equipment at the well to do the pumping or equipping the well with a pumping jack operated from a central power plant. The present invention contemplates the provision of an oscillatory walking beam, the strokes of which are reversed by means of a reciprocable crosshead, the latter of which is driven by any suitable power plant. I also provide a reciprocable counterweight which is operatively associated with the crosshead through the medium of a body of fluid so that any force exerted on the crosshead by the well load will be neutralized by the counterweight.

One form which the invention may assume is exemplified in the following description and illustrated by way of example in the accompanying drawings, in which:

Fig. 1 is a perspective view of a pumping unit embodying the preferred form of my invention.

Fig. 2 is a longitudinal section taken centrally through the pumping unit disclosed in Fig. 1.

Referring more particularly to the accompanying drawings, 10 indicates a base structure which may be mounted on a suitable foundation contiguous to the mouth of a well 11. The base 10 may be constructed in any suitable manner and is here shown as formed of longitudinal channel beams 12 connected by transverse members 14 to form a substantially rectangular base. Mounted on the base is a pair of bearings 15 carrying a drive shaft 16 upon which a pulley 17 is keyed or otherwise secured.

To drive the drive shaft 16 a belt 18 is connected with the pulley 17 and with a pulley 19 secured on the shaft of an electric motor 20. This latter is suitably supported by the base 10. It is to be understood, however, that any other suitable type of power plant or power drive may be substituted for that just described without departing from the spirit of the invention.

Also secured on the drive shaft 16 is a pinion 21 which is in mesh with a gear 22 secured on a jack shaft 23. This shaft 23 extends transversely of the base 10 and is journalled in suitable bearings 24 carried by the base. Extending vertically of the base adjacent the jack shaft 23 is a crosshead guide structure 25 within which a crosshead 26 is guided for vertical reciprocation. To reciprocate this crosshead 26, at its opposite end it is connected with a pair of connecting rods 27 which are vertically disposed and which are connected at their opposite ends to crank arms 28 carried at the outer ends of the jack shaft 23.

It is obvious, therefore, that when the motor 20 is placed in operation it will, through the medium of the pulleys 19 and 17 and the belt 18, drive the pinion 21 which will in turn revolve the jack shaft 23 through the medium of the gear 22. Rotation of the shaft 23 will revolve the crank arms 28 and the rotary movement of these arms 28 will be translated into vertical reciprocation of the crosshead through the medium of the connecting rods 27.

At the end of the base opposite the crosshead guide structure 25 is a walking beam compensating anchor 29 which comprises a pair of vertical members 30, 31, respectively, secured at their lower ends to the base structure 10. At its upper end the walking beam compensating anchor 29 is pivotally connected to one end of a horizontally disposed walking beam 30. This walking beam 30 extends longitudinally of the frame to a point beyond
the crosshead guide structure 25, and over the well 11. It will also be noticed from the drawings that the walking beam 30 extends between the two side portions of the crosshead guide structure 25 so as to bear on the crosshead 26. It is intended that vertical reciprocation of the crosshead oscillates the walking beam about its pivotal connection with its compensating anchor. That is to say, upward movement of the crosshead 26 will be transmitted to the walking beam 30, and when the crosshead 26 is lowered the well load will cause the walking beam to descend.

The connection between the crosshead and the walking beam comprises a semi-cylindrical bearing member 31 on the underside of the walking beam which bears in a complementary recess on the top of the crosshead 26. Due to the fact that the walking beam compensating anchor 29 is pivoted both to the frame and to the walking beam, the bearing 31 on the walking beam will travel in a path parallel to the path of travel of the crosshead 26.

It is obvious, therefore, that when the crosshead 26 moves upwardly that the forward end of the walking beam will be elevated and that when the crosshead commences to descend, the weight of the well load on the end of the walking beam will cause the latter to descend in unison with the crosshead.

Reference being had to Fig. 2, it will be seen that the forward end of the walking beam is fitted with a bearing pad 32 through which the sucker rod 33 of the well pump extends. Above the bearing pad 32 of the walking beam, the sucker rod is fitted with a bearing member 34 which bears on the bearing pad 32 of the walking beam.

I intend to provide counterbalancing means for fully counterbalancing the well load so that the power plant of the pumping unit will be merely called upon to reciprocate the crosshead, and through it oscillate the walking beam. I accomplish this by providing a pair of cylinders 35 and 36 which are supported in a vertical position by the base 10. The lower ends of the cylinders communicate through the medium of a conduit 37.

The cylinder 35 is disposed directly beneath the crosshead 26 and reciprocably mounted in the cylinder is a plunger or piston 38 which is connected to the crosshead 26 by a pitman, so that vertical reciprocation of the crosshead 26 will cause the piston 38 to vertically reciprocate in the cylinder 35.

Reciprocably mounted in the cylinder 36 is the piston 40 having a vertically extending pitman 41. This pitman is connected at its end with a guide sleeve 42 telescoping over the upper end of the cylinder 36. Mounted on this guide sleeve 42 is a counterweight 43 which is intended to be of the same weight as the well load.

In the cylinders 35 and 36 and in the conduit 37 is a body of liquid or fluid which acts as a medium to cause the pistons in the different cylinders to operate in unison. That is to say, when the walking beam 30 is moved downwardly due to the weight of the well load, this force will be transmitted to the piston 38 and through the fluid to the piston 40, tending to raise the counterweight 43. As this counterweight is of the same weight as the well load, the well load will be fully counterbalanced and the only load imposed on the power plant 20 will be the force necessary to reciprocate the crosshead 26.

In operation of the device, it is constructed and assembled substantially as illustrated and described and mounted in cooperative relation to a deep well. The walking beam is then connected to the sucker rod of the well pump and the motor 20 is placed in operation. This, as previously described, causes the crosshead 26 to be vertically reciprocated through the medium of the mechanical elements mentioned.

Upon upward movement of the crosshead, the piston 38 in cylinder 35 will elevate and the counterweight 43 will cause the piston 40 to follow the descending liquid level in the cylinder 36. As the counterweight 43 will be constantly exerting its weight on the column of fluid in the cylinder 36, and as the counterweight is substantially of the same weight as the well load, the motor 20 will be able to elevate the crosshead 26 without having the well load imposed thereon, as the force exerted against the piston 38 to elevate it will be the same as the resistance of the well load to the elevation of the crosshead.

In descending, the well load will be transferred through the crosshead 26 to the piston 38 and this force through the fluid will be transmitted to the piston 40 in cylinder 36, and lowering movement of the piston 38 will be resisted by the weight of the counterweight 43 connected with the piston 40. Therefore, the counterweight 43 will neutralize the well load and consequently relieve the power plant of all unnecessary load.

I may prefer to incise the gears within a housing so that they may be run in lubricant. Likewise, I may provide anti-friction bearings for the different parts so that the amount of power expended in operating the pumping unit will be minimized.

From the foregoing it is obvious that I have provided a pumping unit requiring a minimum of power for operation due to the fact that the well load may be fully counterbalanced. Likewise, I desire to point out that I have avoided mechanical arrangements in counterweighting and have substituted therefor a hydraulic medium unlikely...
to become out of order or in need of repairs and adjustments.

It is obvious that it is only necessary to maintain the plungers or pistons properly packed to prevent the fluid from leaking by the plungers to maintain the structure in perfect operating condition. I also desire to point out that the weight of the counterweight 43 may be changed to suit the well load, as it is only necessary to estimate the well load and either increase or reduce the counterweight mounted on the sleeve 42.

While I have shown the preferred form of my invention, it is to be understood that various changes may be made in its construction by those skilled in the art without departing from the spirit of the invention, as defined in the appended claims.

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

1. A pumping unit comprising an oscillatory walking beam pivoted at one end and adapted to be connected at the free end with the sucker rod of a pump to operate the same, a reciprocable crosshead operatively associated with the walking beam adjacent the free end to operate the same, a pair of communicating cylinders confining a body of fluid, a crosshead weight on one of said cylinders and unconnected with the walking beam, a piston in each cylinder, said pistons being opposed, one piston being connected to the crank arm of the other piston being connected to the crosshead whereby a load imposed on the crosshead will be neutralized by the weight of the counterweight.

2. A pumping unit comprising a substantially horizontally arranged walking beam pivoted at one end and adapted to be connected at the free end with the sucker rod of a pump and to be oscillated to operate the pump, a crosshead guided for vertical reciprocation and connected with the walking beam, a power plant operatively connected with the crosshead to vertically reciprocate the same, a vertically reciprocable counterweight unconnected with the walking beam, intercommunicating fluid-confining cylinders, and pistons therein connected with respectively the counterweight and the crosshead to operatively associate the same whereby a load imposed upon the crosshead will be neutralized by the weight of the counterweight.

3. A well pumping unit comprising a base structure, a vertically arranged member pivoted to the base structure and extending vertically therefrom, a horizontally disposed walking beam pivoted at one end to the upper end of said vertically arranged member, the other end of the walking beam being adapted to be operatively connected to the sucker rod of a pump to operate the same, a crosshead guided for vertical reciprocation and operatively connected with the walking beam adjacent the free end thereof to oscillate the same, a power plant operatively connected with the crosshead for reciprocating the same, a counterweight guided for vertical reciprocation and unconnected with the walking beam, a pair of vertically arranged and communicating cylinders confining a body of fluid, a piston in each cylinder, said pistons being opposed, one piston being connected with the crosshead beneath the walking beam adjacent the free end thereof, the other piston being connected with the counterweight whereby the weight of the counterweight will neutralize the load placed on the crosshead through the walking beam.

4. A pumping unit comprising an oscillatory walking beam arranged in substantially a horizontal plane and pivoted at one end and adapted to be operatively connected adjacent its free end to the sucker rod of a pump to operate the same, a crosshead adapted to reciprocate in a vertical plane and operatively associated with the walking beam adjacent the free end thereof to operate the same, a counterweight unconnected with the walking beam and adapted to reciprocate vertically, a pair of vertically arranged cylinders disposed one adjacent the crosshead and one adjacent the counterweight, the lower ends of said cylinders being in communication through a conduit, fluid confined within said cylinders, a piston inserted within the upper end of each cylinder, one piston being connected with the crosshead adjacent the free end of the walking beam, the other piston being connected with the counterweight whereby a load imposed upon the crosshead will be neutralized by the counterweight.

5. A well pumping unit comprising a base structure, a compensating anchor pivoted at its lower end to the base structure, a walking beam arranged horizontally and pivoted at one end to the upper end of the compensating anchor, a crosshead guide arranged vertically at the end of the base structure opposite the compensating anchor and adjacent the free end of the walking beam, a crosshead guided for vertical reciprocation in said guide and connected with the cross-head adjacent the free end thereof, an electric motor supported by the base, a drive shaft journaled on the base, a drive connection between the motor and said drive shaft, a counter shaft journaled on the base, gears connecting the drive shaft to the countershaft crank arms on the drive shaft, connecting rods connecting said crank arms to the crosshead whereby operation of the motor will vertically reciprocate the crosshead, and a counterweight unconnected with the walking beam, and connecting means between the...
counterweight and cross head including intercommunicating fluid-confining cylinders and pistons therein connected with respectively the crosshead and counterweight.

6. A well pumping unit comprising a base structure, a compensating anchor pivoted at its lower end to the base structure, a walking beam arranged horizontally and pivoted at one end to the upper end of the compensating anchor, a crosshead guide arranged vertically at the end of the base structure opposite the compensating anchor and adjacent the free end of the walking beam, a crosshead guides for vertical reciprocation in said guide and connected with the walking beam adjacent the free end thereof, an electric motor supported by the base, a drive shaft journalled on the base, a drive connection between the motor and said drive shaft, a countershaft journalled on the base, gears connecting the drive shaft to the countershaft crank arms on the drive shaft, connecting rods connecting said crank arms to the crosshead whereby operation of the motor will vertically reciprocate the crosshead, a counterweight guided for vertical reciprocation on the base, a pair of vertical cylinders arranged one adjacent the crosshead and one adjacent the counterweight, said cylinders being connected at their lower ends by a conduit, fluid confined in said cylinders, and a piston in each cylinder, said pistons being opposed, one piston being connected with the crosshead, one piston being connected to the counterweight whereby the weight of the counterweight will neutralize the load placed on the crosshead.

7. A pumping unit comprising an oscillatory walking beam arranged in substantially a horizontal position and pivoted at one end and adapted to be operatively connected at its free end to the sucker rod of a pump to operate the same, a crosshead connected with the walking beam adjacent the free end thereof, a pair of vertically arranged cylinders confining a body of fluid, one of the cylinders being located below the said crosshead, a piston inserted within the upper end of each cylinder, one piston being connected with the crosshead, a guide sleeve telescoping the other cylinder and connected with the piston thereof, and a counterbalancing weight mounted upon the guide sleeve.

8. A pumping unit comprising a base, a fixed guide at one end of the base, a pivoted anchor at the opposite end of the base, a walking beam pivoted at one end to the anchor and having its opposite end engaging the fixed guide, a crosshead mounted on the guide and engaging the walking beam adjacent its free end, a motor on the base, connecting means between the motor and cross head, cylinders at opposite ends of the base, a conduit connecting the cylinders, a coun-