May 25, 1937. R. R. BLOSS ET AL 2,081,140

COUNTERBALANCING DEVICE

Filed Oct. 26, 1927 4 Sheets-Sheet 1

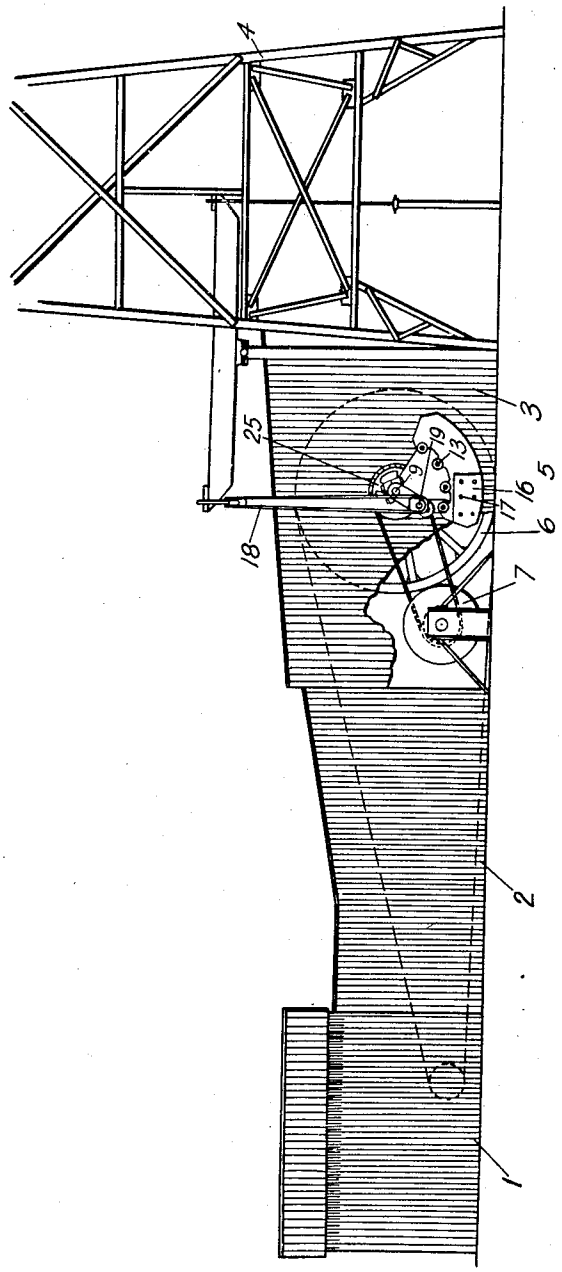


Fig. 1

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COUNTERBALANCING DEVICE

Filed Oct. 26, 1927 4 Sheets-Sheet 2

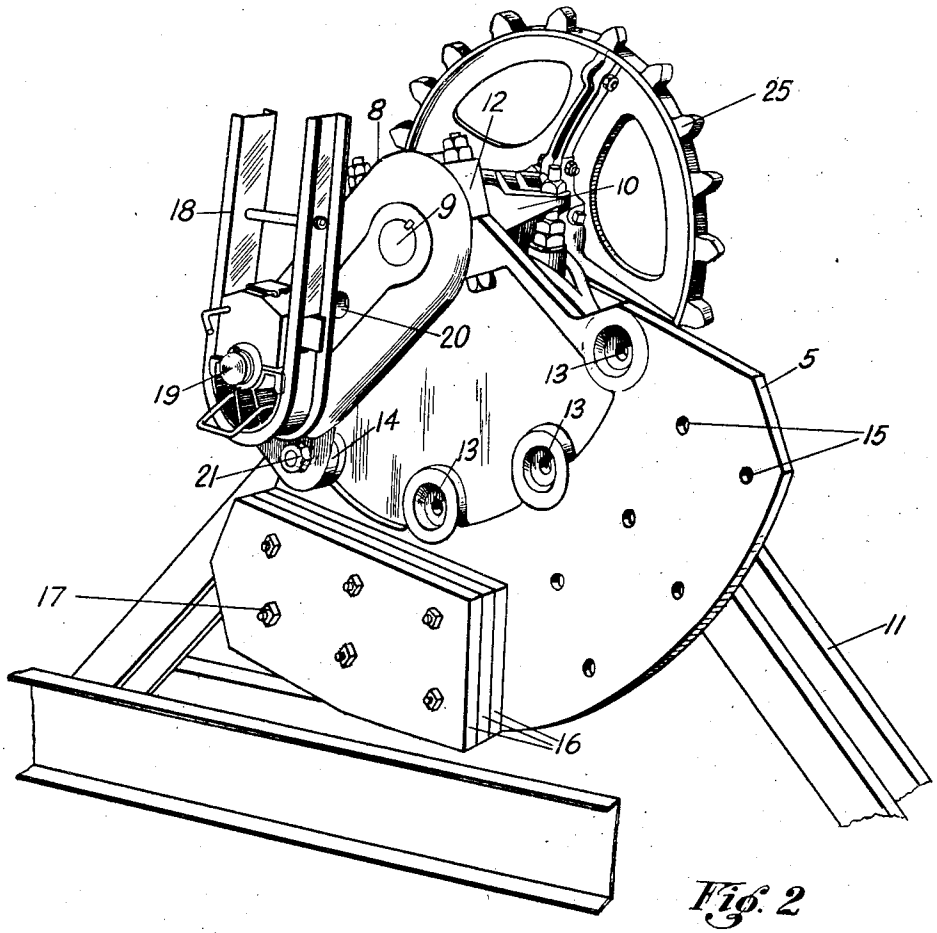


Fig. 2

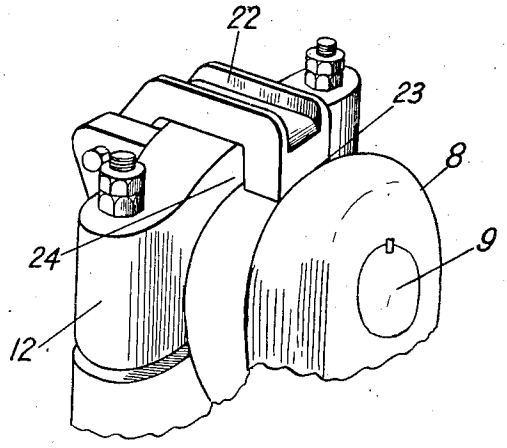


Fig. 3

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COUNTERBALANCING DEVICE

Filed Oct. 26, 1927 4 Sheets-Sheet 3

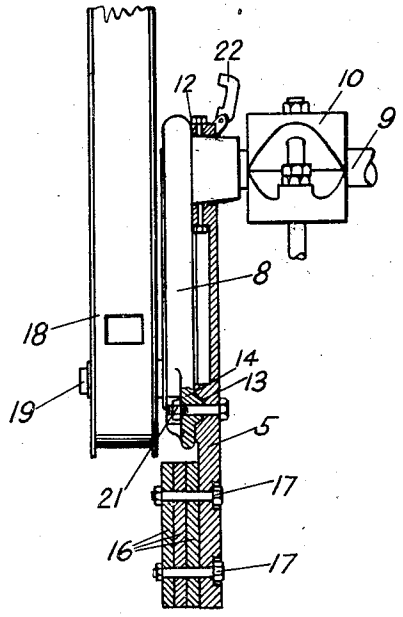


Fig. 4

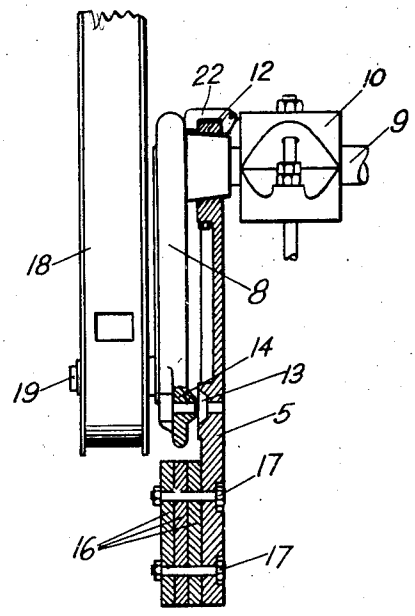


Fig. 5

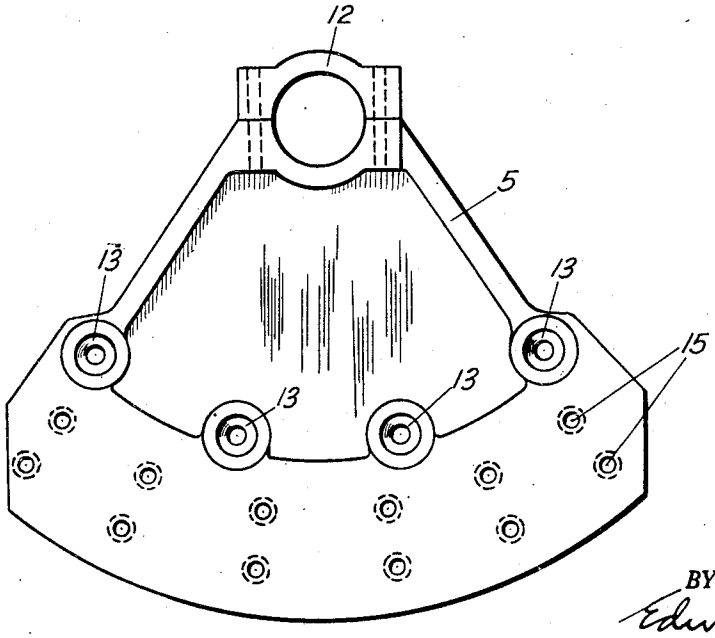


Fig. 6

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COUNTERBALANCING DEVICE

Filed Oct. 26, 1927 4 Sheets-Sheet 4

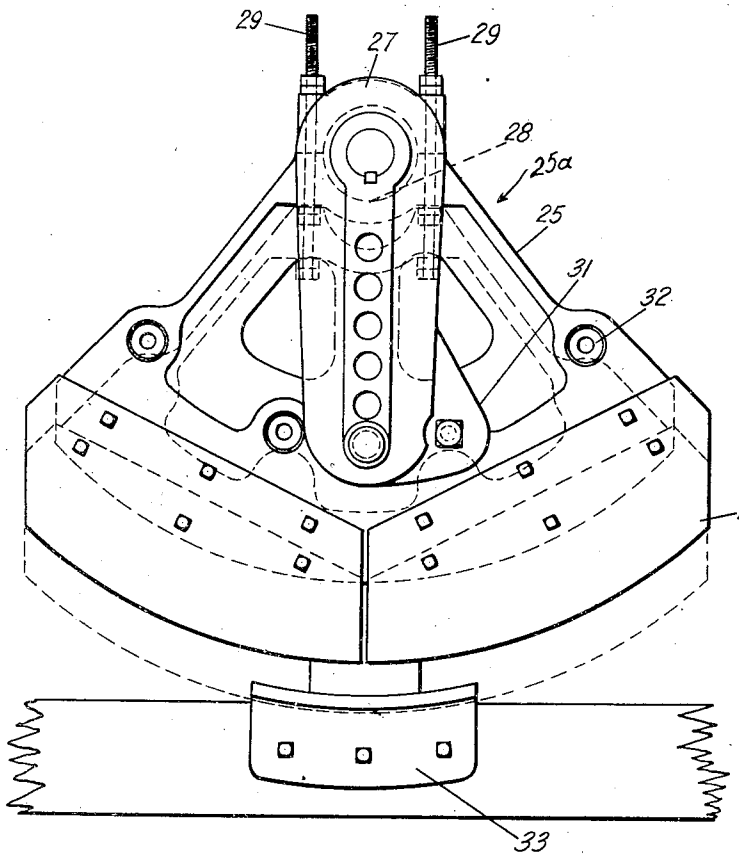


Fig. 7

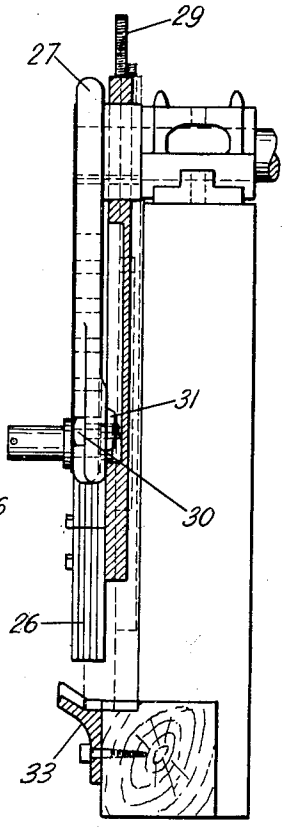


Fig. 8

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AND MECHANISMS
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Patented May 25, 1937 2,081,140

UNITED STATES PATENT OFFICE

2,081,140

COUNTERBALANCING DEVICE

Richard R. Bloss and Roy C. Pfeil, Columbus, Ohio, assignors to The International Derrick & Equipment Company, Columbus, Ohio, a corporation of Ohio

Application October 26, 1927, Serial No. 228,963

14 Claims. (Cl. 74—591)

Our invention relates to a counterbalancing device and, more particularly, to a counterbalancing device that is attached to and operates in conjunction with the crank of an oil well drilling and pumping mechanism.

Certain features of adjustability have been provided in order to meet the normal variations in the weight of the suspended pumping or drilling mechanism and the oil or other fluid above the plunger. Also, features of adjustability have been provided whereby the counterbalance effect may be synchronized with the reactions in the pitman that result from the sucker rod pull. These features of adjustability are calculated to make it possible to eliminate the jerky movements of the various parts of the drilling and pumping mechanism and thereby provide a smooth and uniform operation throughout all cycles of such pumping or drilling.

The fact that our counterbalance is so designed as to be attached to and operate with the crank has decided advantages over a band wheel or walking beam counterbalance. Some of these advantages reside in the fact that the wear and tear on the band wheel and walking beam and the torsional stress on the crank shaft, as produced by ordinary types of the band wheel or walking beam counterbalance, are eliminated. With our design and construction, we avoid unusual stress on any part of the drilling and pumping mechanism with the exception of the crank arm itself.

Other advantages of our device reside in the fact that our counterbalance, being so designed as to be attached to and operate with the crank, is located outside of the rig house whereby it may be readily adjusted and operated. It is so constructed that it may be quickly and easily shifted in an arcuate path with relation to the crank arm to synchronize the counterbalance effect with the load.

In our invention, we have provided a plurality of weight members that may be attached to or detached from the counterbalance. Such weights are provided so as to obtain a greater or lesser counterbalancing effect since, by varying the number of weight members and thereby varying the mass of weight of the counterbalance, any desired counterbalancing effect may be obtained.

Also, we have provided a counterbalancing device of such construction that the counterbalance unit may be attached to or detached from the crank arm and have provided means for positively maintaining the counterbalance unit in an inoperative and non-interfering position with respect to such arm.

Various other advantageous features will appear from the following detailed description and the preferred embodiment of our invention may be seen in the accompanying drawings wherein similar characters of reference designate corresponding parts and wherein:

Figure 1 is a side view showing the application of our invention to an ordinary drilling and pumping rig structure.

Figure 2 is a perspective view of the preferred embodiment of our invention.

Figure 3 is a perspective view of the latch which we employ to positively maintain the counterbalancing unit in inoperative and non-interfering position with respect to the crank arm.

Figure 4 is a side view, partly in section, showing the counterbalancing unit in cooperative relation with the crank arm of an oil well drilling or pumping mechanism.

Figure 5 is a view similar to Figure 3 but showing the counterbalancing unit in a position of inoperative relation with the crank arm of an oil well drilling or pumping mechanism and showing the latch in a position to prevent the counterbalancing unit from entering into cooperative relation with the crank arm or from interfering therewith.

Figure 6 is a front elevation of the counterbalancing unit.

Figure 7 is a side elevation of a modified form of our counterbalancing attachment shown applied to the crank, with detached position shown in dotted lines.

Figure 8 is an end elevation of a crank showing our counterbalance attachments, partially in section, with detached position shown in dotted lines.

Referring to the drawings, particularly to Figure 1, we have shown the usual drilling rig structure comprising the engine house 1, belt house 2, band wheel house 3 and derrick structure 4. In this figure, we have shown a novel counterbalancing unit 5 as being disposed on the outside of the house 3 which encloses the band wheel 6. A sand reel 7 is also disposed on the outside of the house 3.

As best shown in Figure 2, a crank arm 8 is mounted upon and keyed to a crank shaft 9 which, in turn, operates in a bearing 10 that may be supported in a jack-post or similar structure 11.

The counterbalance unit 5 is suspended from the shaft 9 by mounting it upon the hub of the crank arm preferably in a position between the crank arm 8 and the jack-post or similar supporting structure 11 by means of the split bearing 12. Such counterbalance unit is provided with a plurality of tapered holes 13 which cooperate with a tapered boss 14 on the crank arm 8 and provide a means for adjusting the weight center of the counterbalance unit to a multiplicity of positions with respect to the crank arm.

In the lower part of the counterbalance unit, a plurality of holes **15** are provided as a means whereby supplemental weight elements **16** may be attached to or detached from the counterbalance unit as desired. These suplemental weight elements **16** may be attached to the counterbalance unit in any desired number by means of bolts **17**. A pitman **18** that may be of any preferred form but is preferably of the form shown in Figures 1 and 2 is shown as being attached to the crank arm **8** by means of a wrist pin **19**. A plurality of holes **20** are provided to permit adjustment of the wrist pin to different positions along the crank arm.

Referring to Figures 4 and 5 of the drawings, we have shown the counterbalance unit **5** in both operative and inoperative relation to the crank arm **8**. As shown in Figure 4, the tapered boss **14** is fitted in one of the tapered holes **13** and a bolt **21** passes through the counterbalance unit and the crank to hold the tapered boss within the tapered hole in which it is disposed. A latch **22** that is hinged to the upper part of the slit bearing **12** is shown in raised or inoperative position.

Referring to Figure 5, the counterbalance unit **5** is shown in inoperative position with relation to the crank arm **8'** This is accomplished by removing the bolt **21** and moving the counterbalance unit along the shaft **9** away from the crank arm **8** enough so that the tapered boss **14** will be disengaged from the tapered hole **13**. At this time, the latch **22** is manually moved to such a position that it will be between the shoulder **23** of the crank and the shoulder **24** of the counterbalance unit bearing to prevent return movement of the counterbalance unit. In order that the counterbalance unit may be moved away from the crank more easily, the portion of the hub of the crank on which the counterbalance unit is suspended may be machined so as to taper slightly in a direction away from the crank (see Figure 5).

A modified form of our invention is shown in Figures 7 and 8. In this form, we have shown a counterbalance unit **25***a* having supplemental weights **26** and swung from the hub of the crank by means of a semi-circular clamp **27** cooperating with a semi-circular recessed portion **28** of the counterbalance unit **25***a*. These clamp members are designed to embrace the hub of the crank and are normally held in clamping relation to this hub by means of bolts **29** which are of extra length, for a purpose to be described. The counterbalancing attachment **25** is designed to be held in cooperative relation to the crank by means of a bolt **30**, which may extend through the perforated lug **31** of the crank and through any one of the apertures **32**, with which the lug **31** is adapted to cooperate. A plurality of these apertures **32** are provided for adjusting the position of the counterbalancing attachment with relation to the crank, as described in the original form of our invention.

Carried upon the main sill of the rig, we have provided a bracket **33** or other supporting shelf. This bracket is intended to receive and support the counterbalancing attachment when the nuts upon the bolts **29** are sufficiently loosened to permit the counterbalancing attachment to be entirely disconnected from the crank hub. The bolts **29** are of such a nature that, after disconnecting the bolt **30**, the attachment may be moved axially of the crank shaft away from the crank and then lowered to rest upon the shelf **33** and to entirely relieve the crank hub or shaft of any supporting action. At the same time, the counterbalancing attachment remains in suitable position so that it may be again applied, when desired.

By referring to the preceding description and the drawings attached hereto, it will be clearly understood that we have provided a counterbalance unit that will permit any desired counterbalancing effect to be obtained. This desired counterbalancing effect may be obtained in several ways, the most simple of which would be moving the counterbalance unit and the crank relatively until the tapered boss **14** on the crank arm **8** is in cooperative relation to the desired tapered hole **13** in the counterbalance unit. Another means of obtaining the desired counterbalancing effect is to vary the number of the supplemental weight elements on the counterbalance unit **5**. Still another means of obtaining the desired counterbalancing effect is by adjusting the pitman **18** to various positions along the crank arm **8**.

Also, by referring to Figure 1 of the drawings, it will be apparent that our counterbalance unit, when assembled, is located outside of the band wheel house **3** whereby it may be readily adjusted and operated and not inside where the space is cramped and the counterbalance device would be more or less inaccessible. The siding of the band wheel house **3** is between the band wheel and the sprocket wheel **25** which provides a means for driving the sand reel **7**. Furthermore, our device is so constructed that the counterbalance unit may be quickly and easily shifted in an arcuate path, with relation to the crank arm, to synchronize the counterbalance effect with the load.

To those familiar with the art, it will be clearly understood that we have provided a counterbalancing device whereby any desired counterbalancing effect may be obtained and have provided a means whereby this counterbalancing device may be moved and positively maintained out of operative and interfering relation with the other mechanical parts of the drilling or pumping structure. It will also be clear that, by providing means for altering the position of the counterbalance unit with respect to the crank, we have provided a counterbalance that makes it possible to synchronize the counterbalance effect with the reactions in the pitman that result from the sucker rod pull.

It will be seen that we have provided a counterbalance element which may be drawn into rigid relation to the crank by means of a tapered boss designed to fit in any of the complementally tapered sockets. The boss is large and, therefore, has a large shearing area. It permits the use of bolts for securing the crank and counterbalance together and, at the same time, the tapered boss and sockets ensure a very tight fit which cannot be economically obtained by the use of bolts alone.

Having thus described our invention, what we claim is:

1. A means for counterbalancing a string of oil well tools and associated mechanism comprising a weight structure constructed for attachment to a crankshaft and normally in a position of cooperative relation with the crank arm mounted on said crankshaft, said weight structure being movable laterally in the direction in which the crankshaft extends toward and away from said crank arm without disturbing the connection between said weight structure and said crankshaft, and interfitting means for connecting said weight

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structure to said crank arm so that it will move therewith as a unit.

2. An attachment for the crankshaft of oil well pumping mechanism comprising a pendulous weight structure having sockets disposed about the face thereof and a crank arm having a boss thereon, said sockets being complemental to said boss and means for securing said boss within any of said sockets.

3. An attachment for the crankshaft of an oil pumping mechanism comprising a crank arm, a weight structure suspended from said crankshaft, said weight structure being movable axially of said crankshaft into position for connection to said crank arm and movable out of such position, and interfitting means for connecting said weight structure to said crank arm so that said weight structure and said crank arm will move as a unit.

4. An attachment for the crankshaft of an oil pumping mechanism comprising a crank arm, a weight structure suspended from the hub of the crank arm, said weight structure being adjustable along the horizontal axis of said crank arm hub and said crank arm hub being tapered to facilitate adjustment of said weight structure in the direction in which said crank arm hub is tapered.

5. A counterbalancing attachment for the crank arm of a well-pumping mechanism comprising a weight movable towards and from the crank arm, said weight being provided with a plurality of sockets therein any one of which may be caused to interfit with a portion of said crank arm in such a way as to ensure that rotary movement of said crank arm will be accompanied by rotary movement of said weight whereby the center of gravity of said weight may be caused to assume different positions with relation to the said crank arm.

6. A counterbalancing attachment for the crank arm of a well-pumping mechanism comprising a weight designed to be connected to the crank arm in a manner to add its weight thereto on the same side of the crankshaft and movable towards and from the crank arm, said weight being provided with a plurality of sockets therein disposed in an arcuate line and any one of which may be caused to interfit with a portion of said crank arm in such a way as to ensure that rotary movement of said crank arm will be accompanied by rotary movement of said weight, and being adjustable to a position to permit said crank arm to move freely without being affected by said weight.

7. A counterbalancing attachment for the crank arm of a well-pumping mechanism comprising a weight designed to be connected to the crank arm in a manner to add its weight thereto on the same side of the crankshaft and movable towards and from the crank arm, said weight being so formed in relation to said crank arm that it may be caused to assume interfitting relation with said crank arm in such a way as to ensure that rotary movement of said crank arm will be accompanied by rotary movement of said weight, and being adjustable to a position to permit said crank arm to move freely without being affected by said weight.

8. A counterbalancing attachment for the crank arm of a well-pumping mechanism comprising a weight designed to be connected to the crank arm in a manner to add its weight thereto on the same side of the crankshaft and movable towards and from the crank arm, said weight being provided with a socket therein for interfitting with a portion of said crank arm in such a way as to ensure that rotary movement of said crank arm will be accompanied by rotary movement of said weight, and being adjustable to a position to permit said crank arm to move freely without being affected by said weight.

9. In combination with a crankshaft of an oil, gas or artesian well drilling and pumping mechanism, a crank, a pendulous weight, a tapered boss on said crank, a plurality of tapered sockets on said weight any one of which is adapted to receive said tapered boss and means for securing said crank and said weight together.

10. In combination with a crankshaft of an oil, gas or artesian well drilling and pumping mechanism, a crank arm, a pendulous weight, a tapered boss on said crank arm, and a plurality of tapered sockets on said weight, any one of which is adapted to receive said tapered boss, said boss and sockets being provided with bolt holes therethrough.

11. A counterbalance attachment for well-pumping mechanism comprising, in combination with a crank arm, a pendulous weight so mounted that it may be attached to said crank arm, and means for connecting said pendulous weight to such crank arm in such a manner that it will rotate therewith as a unit, said means being of such construction that the said pendulous weight may be entirely disconnected from said crank arm, said connecting means including a bolt which passes through aligning openings formed in said weight and crank arm and interfitting means other than said bolt on said weight and crank arm.

12. A counterbalance attachment for well-pumping mechanism comprising, in combination with a crank arm, a pendulous weight so mounted that it may be attached to said crank arm, and means for connecting said pendulous weight to such crank arm in such a manner that it will rotate therewith as a unit, said means being of such construction that the said pendulous weight may be entirely disconnected from said crank arm, said connecting means including interfitting portion carried by said weight and crank arm and a connecting member other than said interfitting portions for securing said interfitting portions in cooperative relation.

13. An attachment for the crankshaft of a well-pumping mechanism comprising a crank arm and a weight structure disposed adjacent each other, means for connecting the crank arm to the weight structure, said means including a boss formed on one of said members and a complemental socket formed on the other of said members, and means for securing said crank arm and said weight structure in cooperative relation to maintain said boss in said socket.

14. In combination, a crankshaft for a pumping mechanism, a crank arm on said crankshaft, a weight structure suspended from said crankshaft adjacent said crank arm, means for directly connecting said crank arm to said weight structure to prevent relative movement thereof, said weight structure being adjustable axially of said crankshaft to a position of spaced inoperative relation to said crank arm.

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