Nov. 12, 1940. J. R. MAHAN ET AL 2,221,428

COUNTERBALANCE DEVICE

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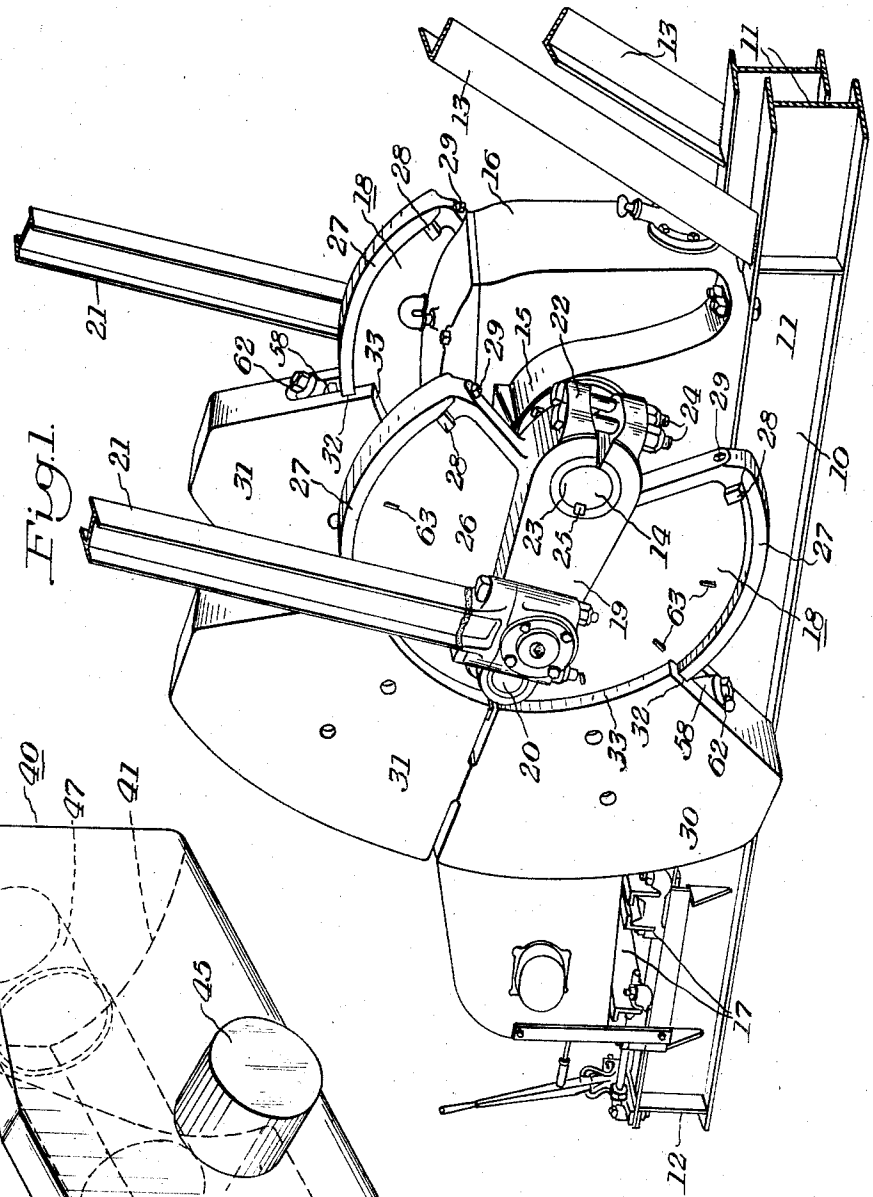


Fig. 1.

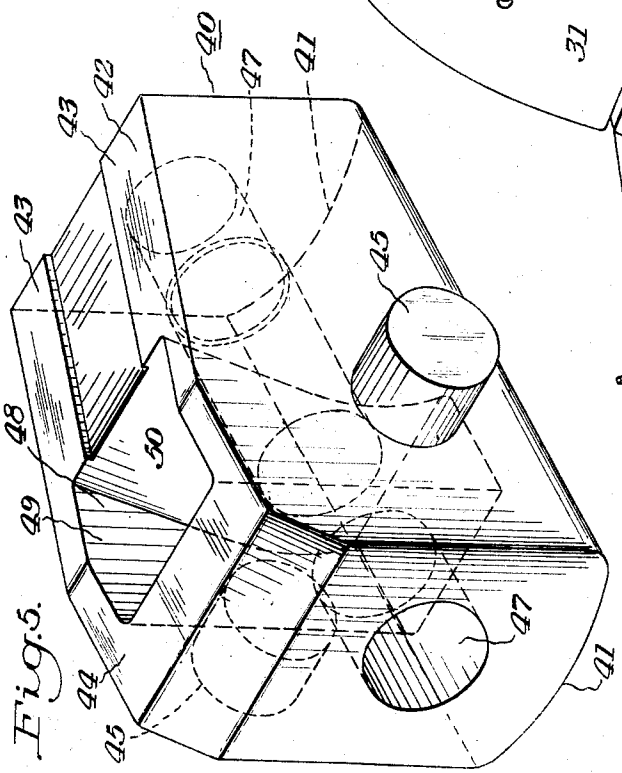


Fig. 5.

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Fig. 2.

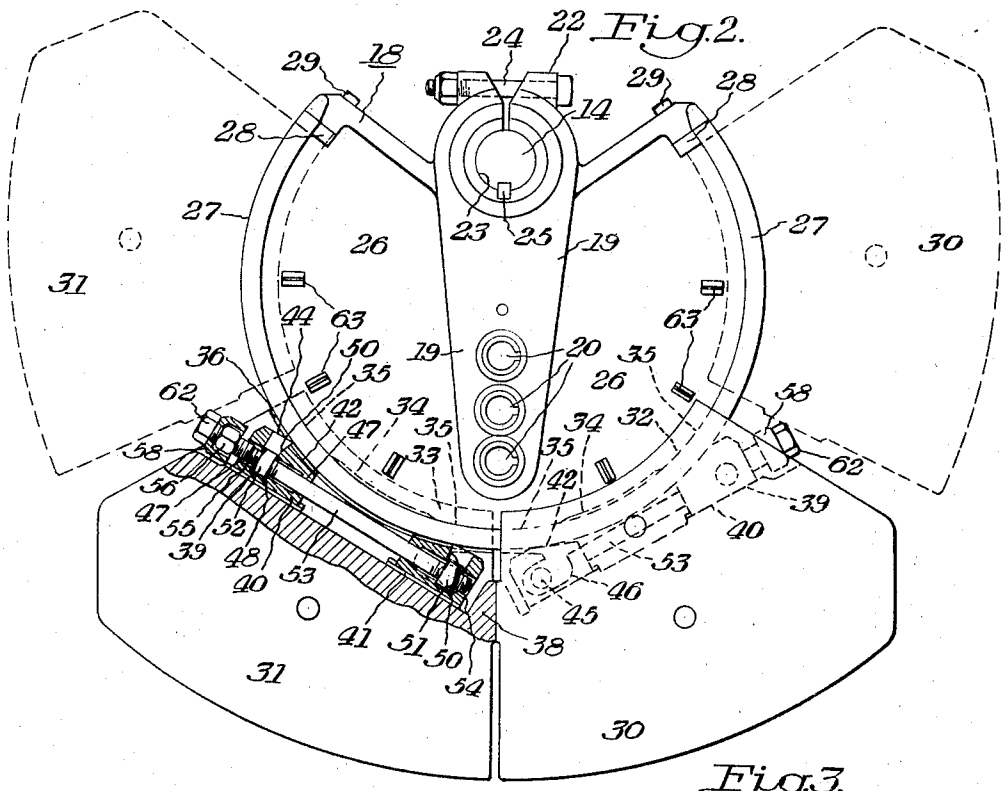
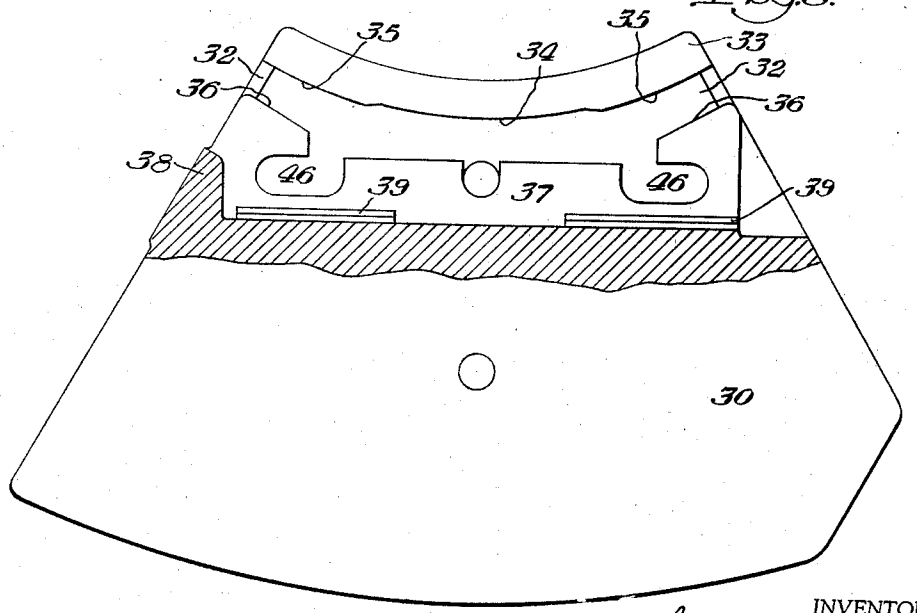


Fig. 3.



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COUNTERBALANCE DEVICE

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Fig.4.

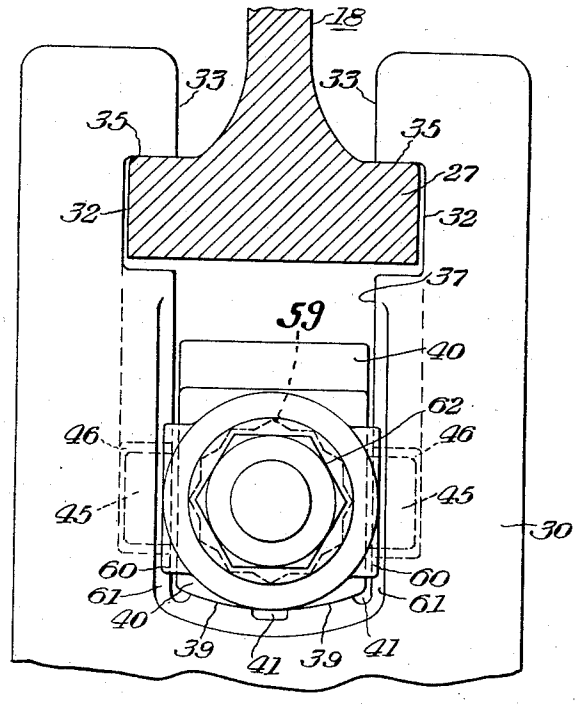
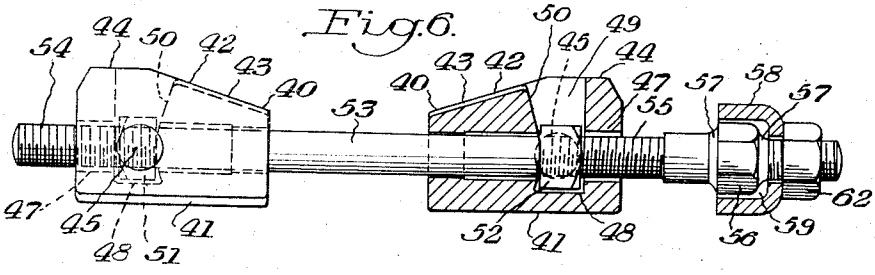


Fig.6.



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Fig. 7.

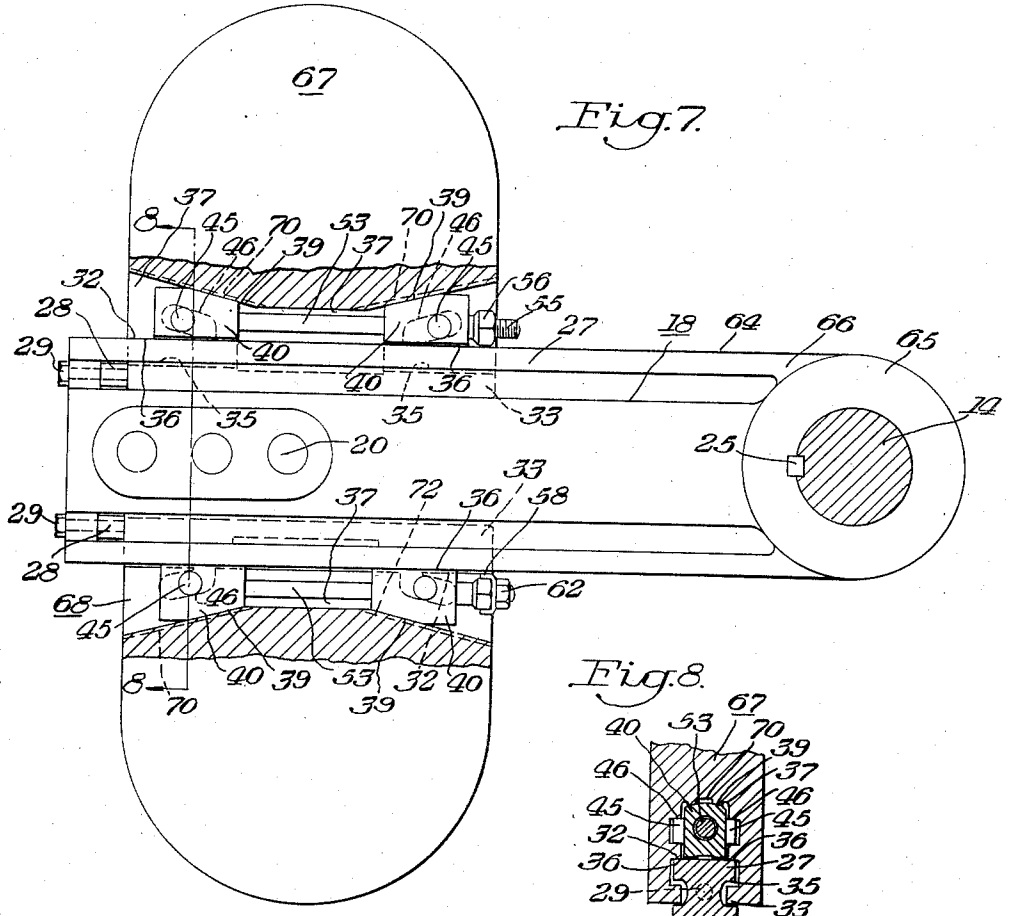
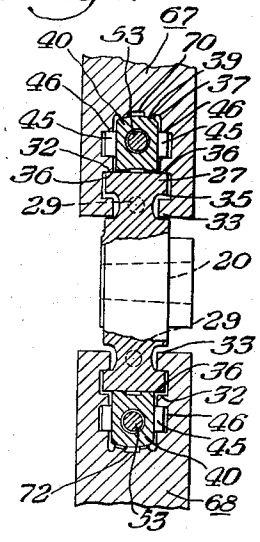


Fig. 8.



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Patented Nov. 12, 1940 2,221,428

UNITED STATES PATENT OFFICE

2,221,428

COUNTERBALANCE DEVICE

Joseph R. Mahan and John B. Picard, Toledo, Ohio, assignors to The National Supply Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application December 29, 1939, Serial No. 311,544

18 Claims. (Cl. 74—591)

This invention relates generally to counterbalance devices for crank shafts of oil well drilling and pumping apparatus and more particularly to improvements in the construction and the manner of attaching counterbalance weights to their supports.

The principal object of this invention is the provision of a unitary counterweight structure and improved means for securing the same to a crank shaft or crank member for use with oil well drilling and pumping apparatus.

Another object is the provision of an improved arcuate disk-type crank member arranged to pendulously and slidably support counterweights adjustably secured thereto.

Another object is the provision of improved double wedge clamping means for securing the counterweight to a support.

Another object is the provision of wedge means for securing a counterweight to its support.

Another object is the provision of an arcuate counterweight support arranged to be secured to a shaft and a counterweight slidably mounted on the support for adjustment to any selected position and locked thereto by oppositely disposed wedges engaging therebetween.

Other objects and advantages appear from the following description and claims.

A practical embodiment illustrating the principles of this invention is shown in the accompanying drawings wherein:

Fig. 1 is a perspective view of a pumping unit with parts broken away showing a crank shaft having two crank arms with counterweights attached thereto.

Fig. 2 is a side elevation of the crank arm having counterbalance weights attached thereto, one of the weights being shown in section illustrating the application of the wedge clamping members.

Fig. 3 is a sectional view of a counterweight member.

Fig. 4 is an end elevation of the weight member applied to the crank arm disk.

Fig. 5 is a perspective view of one of the wedges illustrated in Fig. 2.

Fig. 6 is a sectional view of the counterweight clamping assembly.

Fig. 7 is a side elevation of a radial crank arm having two counterbalance weights attached thereto, a portion of each weight being shown in section to illustrate the clamped and unclamped position of the wedge blocks.

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 7.

Referring to Fig. 1 of the drawings, 10 represents the base of the pumping unit arranged to support the pumping jack and the operating mechanism therefor. The base 10 comprises a pair of steel beams 11 disposed in parallel relation and joined together at their ends by the transverse members 12 welded thereto.

13 represents a pair of braces welded at their lower ends to the beams 11 and inclining upwardly for supporting the Samson post of the jack structure just below the saddle which is not shown.

The crank shaft 14 is rotatably supported in the spaced bearing supports 15 each of which is mounted on the spaced beams 11. These bearing supports are cast integral with the reduction gear housing 16. The reduction gear drive in the housing operates the crank shaft 14 and the power is supplied thereto from a motor arranged to be supported on the bed plates 17 at the rear of the machine. The bed plate is arranged to receive either an electric motor or an internal combustion machine, depending upon the class of service required and the location of the pumping unit.

When a double pitman and crank structure is employed the ends of the crank shaft 14 extend through the bearing in the supports 15 and are arranged to receive the crank members 18. Each crank is provided with a radially extending crank arm 19 having a series of transverse openings 20 in axial alinement for receiving the wrist pins to which the free ends of the double pitman 21 are journaled.

Each crank arm 19 is provided with a split head 22 which connects with the transverse opening 23 arranged to receive the end of the crank shaft 14. The extended portions of the split head of the crank arm may be drawn together by the clamping bolts 24, thereby locking the arm to the shaft 14. A key 25 is also provided to prevent relative movement between the crank and the shaft.

The crank member 18 comprises the crank arm 19 and the circular disk 26 formed integrally therewith. The disk is preferably disposed eccentrically with respect to the crank shaft opening 23 in the crank arm but it may be concentric and it is not completely circular in that the section adjacent the crank head is omitted as shown on the drawings. The perimetral edge of the disk 26 is T-shaped with the flanges 27 extending on each side thereof and the ends of which terminate on each side of the crank arm head 22. Transverse openings are formed through the disk 26 below the T-shaped flanges and adjacent

the ends thereof for receiving the stop plates 28 inserted half way through these openings. These plates are held in place by the bolts 29 which pass through holes in the edges of the disk and screw into tapped holes centrally disposed in the plates. If desired a series of these stop plate openings may be made through the web of the T-shaped perimeter of the disk to check the movement of a counterweight beyond the position of the plates.

It is preferable to provide each crank member with two duplicate counterweights 30 and 31. Each counterweight is a single solid member in the form of a segment of a sector and has an inverted T-shaped slot forming the grooves 32 in the arcuate concave edge, which slot is complementary to the T-shaped perimeter of the disk 26. Thus when a stop plate 28 is removed the grooves 32 may be moved over the flanges of the T-shaped perimeter of the disk, thereby pendulously supporting the weight from the periphery of the disk and the weight is freely slidable relative to the disk between the stop plates 28. These counterweights are preferably unitary but may be partible in a plane normal to the axis of the shaft.

The intermediate portion of the undersurface of the inturned flanges 33 on the counterweights is receded as indicated at 34 in Fig. 3, thereby providing the supporting bearing surface 35 adjacent each end of the flanges 33 when the weight is hanging from the disk. If the weight is above the disk the supporting surfaces 36 on the body of the weight, which are oppositely disposed from the surfaces 35, will support the weight on top of the T-shaped perimeter of the disk.

The slot 37 between the opposed edges of the flanges 33 extends down into the weight and one end is open the full way while the other is partially closed by the filler 38. The bottom of this slot is disposed at right angles to a plane bisecting the weight and a plurality of longitudinally extending bearing surfaces 39 raised from the slot bottom adjacent each end thereof form a track of arcuate cross sectional shape for receiving the weight clamping wedge blocks 40. These wedge blocks are provided with an arcuate under surface 41 which mates with the arcuate bearing surfaces 39 on the slot bottom. A portion of the top surface of these blocks is inclined as shown at 42 in Fig. 5 and is provided with flat longitudinally spaced clamping surfaces 43 arranged to engage the perimetral surface of the disk 26 inwardly adjacent the flanges 27. The other portion 44 of the top of the wedge blocks remain out of contact with the disk 26 as shown in Fig. 2.

These wedge blocks fit loosely within the slot 37 of the weight and are provided with cylindrical lugs 45 extending from each side thereof and arranged to be inserted through grooves 32 into the guiding slots 46 formed in the side faces of the slot 37 and parallel to the bottom thereof. The wedge blocks are thus guided by the lugs 45 and the slots 46 limit the outward movement of the lugs, thereby preventing the wedge blocks from accidentally checking the movement of the weight when it is being adjusted or shifted on the disk.

The lugs 45 clear the bottom of the grooves 32 and the slots 46, and the flat inclined clamping surfaces 43 which engage the perimetral surface of the disk cause the wedging blocks to seek their proper position on the arcuate bearing surfaces 39. Thus the perimetral surface of the disk 26, being an unfinished casting, may not be exactly true, causing the wedge blocks to be slightly tilted, but the arcuate mating bearing surfaces provide uniform transmission of the wedging forces between the blocks and the weight.

A hole 47 extends longitudinally through the center of the wedge blocks and is intersected by the well 48 which extends from the top of the block to a plane below the hole 47. The walls of the well adjacent the sides and large end of the block are straight as indicated at 49 but the wall 50 adjacent the small end of the block is arcuate with the maximum point of the curved surface being aligned with the horizontal large diameter of the hole 47 to provide a bearing surface against which the flat face of the clamping nuts 51 and 52 may rock to seek proper alignment of the threaded clamp rod 53 to avoid strains on the latter. This clamp rod loosely fits in the holes 47 of the wedge blocks 40.

The clamp rod 53 is provided with a right hand thread 54 on one end and the left hand thread 55 on the other end. These threads are arranged to receive the nuts 51 and 52 respectively. In assembling, the nuts 51 and 52 are inserted in their respective well 48 of the wedge blocks and are prevented from turning by their engagement with the flat walls 49 of the wells 48. The small ends of the wedge blocks 40 are placed adjacent one another. Both ends of the clamp rod are then screwed into the nuts 51 and 52 by rotating the rod in the direction of the right hand thread. This draws the wedges toward one another in assembled relation and the ends of the rod extend through the blocks. The end of the clamp rod which is selected for operating the same may have a square or hexagonal end formed thereon. However it is preferable to thread a bearing collar on the rod spaced from the end thereof and to provide the collar with a nut as indicated at 56. The nut and the collar are welded together and to the rod as indicated at 57. The operating nut 56 may be locked by the sleeve 58 having a duodecahedral bore 59 which fits thereover and is provided with the lugs 60 extending on each side thereof arranged to engage the outer portion 61 of the slot 37. When the wedges have been tightened the sleeve 58 is placed over the nut 56, thereby preventing the rod 53 from accidentally turning due to vibration or other similar causes. The sleeve 58 is locked in place by the nut 62. When the clamp rod is to be operated the sleeve 58 and the nut 62 may be removed and a socket wrench applied to the nut 56 to rotate the operating rod 53 to move the wedges.

When the wedges 40 have been properly spaced along the operating rod so that the lugs 45 will drop into the slots 46, the clamping assembly is placed in the counterweight with the lugs 45 passing through the grooves 32 until they are just above the open ends of the slots 46, at which time they are permitted to drop therein with the under arcuate surface 41 of the wedge blocks resting on the bearing surfaces 39. The operating rod is then rotated in a counterclockwise direction to draw the wedge blocks away from one another to clear the grooves 32.

The operating or lead rod 53 should be rotated in this direction until the lugs 45 engage the outer ends of the slots 46, using them as reaction surfaces to lock the wedge blocks in their open position. When in this position there is no danger of these blocks shifting accidentally

and interfering with the assembly or adjustment of the weights on the disk.

The counterweight clamping assembly, which is illustrated in Fig. 6, may be said to float and is free to operate in the groove of the counterweight. It is not secured to the weight and thereby obviates the necessity of finishing, drilling or machining the weight casting. This is an important improvement of this invention.

To assemble the weights on the crank arm the stop plates 28 on the disk 26 are removed and the counterweights slid over the T-shaped perimeter with the flanges 27 riding in the slots 32. When the weights clear the ends of the disk the stop plates are secured in position.

When the counterweights have been properly positioned on the disk with respect to the operating or pumping load the operating rods 53 are rotated in a clockwise direction, thus drawing the wedging blocks 40 together and in contact with the rim of the disk, thereby securing the weights against movement. The wedges thus pull the bearing surfaces 35 against the under surface of the flanges 27. The acute angle between the bearing surfaces of the wedge, acting against a circular surface on the perimeter of the disk, together with the fact that these surfaces are that of an unfinished casting, provides a very tight clamping action preventing relative movement between the counterweights and the disk.

When it is desired to readjust the weights on the disk the locking nut 62 and washer 58 are removed and a wrench is applied to the nut 56 for rotating the rod 53 in a counterclockwise direction. Owing to the fact that both wedge blocks are engaged between the disk and the weight the rotation of the rod backs off the wedge block having the least resistance to movement while the other wedge block remains in engagement. The wedge block which first backs out of engagement uses the other wedge block as a reaction surface and proceeds to move until the lugs 45 engage the outer ends of the slots 46. The pitch of both the left and right hand thread is effective in moving this block until it is stopped by the end of the grooves 46 which in turn become the reactive surface for forcing the second wedge block out of engagement. The second block then proceeds to the end of its limit of travel at which time both blocks are held against the outer ends of their corresponding slots 46 by the screw or what has been referred to as locking the wedges in their open position.

This is an important advantage of this invention as the wedge blocks are held against movement longitudinally of the groove in the weight by the screw 53 and vertical movement by the lugs 45 engaging the walls of the slots 46. Thus when the weight is assembled on the arcuate support the wedge blocks of the floating weight clamp assembly may be locked at either limit of their travel.

The construction of this clamping assembly permits the use of fillets in the corners of the casting defining the grooves and slots, thereby providing added strength to the castings. Again the weights being preferably formed as integral unitary structures do not rely on through bolts for retaining them on the disk or in position, and they may be readily loosened, adjusted and tightened in any desired position between the stop plates 28.

An economic advantage is gained by the use of this improved counterweight device in that the rim of the arcuate crank arm and the counterweights are not machined. The use of the wedge blocks for locking the weights to the arcuate arm permit the use of unmachined coacting surfaces between these castings. Again the counterweights being preferably made in a single casting represent an economical saving over the ordinary split type counterweight. To obtain these advantages it is necessary to provide an arcuate crank arm in place of a closed circular arm in order to mount the unitary weight structure on the arm.

Markings 63 are placed on one-half of the face of the disk dividing it into fractional portions so that the weights may be readily adjusted or readjusted to the desired positions thereon.

This wedge block clamping assembly is obviously equally applicable to a radial crank arm having straight T-shaped marginal edges from which the unitary weight structures are pendulously supported. The flanges 27 and 33 being straight obviously require oppositely disposed inclined surfaces for the bearing surfaces 39 in the weight to produce the wedging action. This structure is illustrated in Figs. 7 and 8 wherein the crank member 13 comprises the radial crank arm 64 having the head 65 at one end thereof which is provided with an opening for receiving the crank shaft 14.

The edges of the crank arm are straight and are T-shaped. The inner ends of the flanges forming the T-shaped edge portion terminate at the head 65 as indicated at 66. Transverse openings formed through the web portions adjacent the outer end of the crank arm, receive the stop plates 28 which are held in place by the bolts 29 in the same manner as that described above.

The counterweights 67 and 68 are provided with complementary T-shaped slots formed by the grooves 32 and the flanges 33 for mounting these weights on the crank arm. The slots 37 between the opposed faces of the flanges 33 extend into the weight and are open at both ends. The inclined surfaces 70 at the bottom of the slot 37 of each counterweight are provided with longitudinally extending bearing surfaces 71 raised from the slot bottom. These surfaces receive the complementary inclined surface of the wedge blocks 40. These mating surfaces are preferably arcuate as shown in Fig. 8. The wedge blocks and the clamp rods are assembled and operated in the same manner as that described above.

While for the sake of clearness of illustration, we have shown the use of our improved counterbalance structure in connection with a double pitman for operating a walking beam, it is obvious that our counterbalance structure is equally applicable where a single pitman is used. Again where a load or loads are connected through pull rods to a double crank or to a back crank the counterbalance mechanism may be used on either or both cranks.

We claim:

1. In a counterweight device, the combination of a support arranged to be mounted on a shaft, a counterweight, means interengaging the weight and the support for slidably carrying the weight on the support, and wedge means independent of said first mentioned means arranged to engage between the weight and the support for securing the weight at any desired position relative to the support.

2. In a counterweight device, the combination

of a support arranged to be mounted on a shaft, a counterweight, means interengaging the weight and the support for slidably carrying the weight on the support, a wedge independent of said first mentioned means arranged to engage between the weight and the support for securing the weight at any desired position relative to the support, and means for moving the wedge into and out of engagement.

3. In a counterweight device, the combination of a support arranged to be mounted on a shaft, a counterweight, means interengaging the weight and the support for slidably carrying the weight on the support, a slot longitudinally of the edge of the weight adjacent the support, a wedge block in said slot, and means for moving said wedge block longitudinally of the slot and into engagement with the support for securing the weight to the support in any selected position and for withdrawing the wedge block from engagement to permit adjustment of the weight.

4. In a counterweight device, the combination of a support arranged to be mounted on a shaft, a counterweight, means interengaging the weight and the support for slidably carrying the weight on the support, a slot longitudinally of the edge of the weight adjacent the support, a pair of wedge blocks in said slot, and means for simultaneously moving said wedge blocks into engagement with the support for securing the weight to the support in any selected position and for simultaneously withdrawing the wedge blocks from engagement to permit adjustment of the weight.

5. In a counterweight device, the combination of a support arranged to be mounted on a shaft, a counterweight, means interengaging the weight and the support for slidably carrying the weight on the support, a slot longitudinally of the edge of the weight adjacent the support, a wedge block in said slot, means for moving said wedge block longitudinally of the slot and into engagement with the support for securing the weight to the support in any selected position and for withdrawing the wedge block from engagement to permit adjustment of the weight, and means for locking said wedge block moving means to prevent movement of the wedge block in any position.

6. In a counterweight device, the combination of a support arranged to be mounted on a shaft, a counterweight, means interengaging the weight and the support for slidably carrying the weight on the support, a slot longitudinally of the edge of the weight adjacent the support, a pair of wedge blocks in said slot, means for simultaneously moving said wedge blocks into engagement with the support for securing the weight to the support in any selected position and for simultaneously withdrawing the wedge blocks from engagement to permit adjustment of the weight, and means for locking said wedge block moving means to prevent movement of the wedge blocks in any position.

7. A counterweight support for use on shafts in well pumping apparatus comprising a unitary member provided with a transverse hole for mounting it on a shaft, a portion of the edge of said member being formed in a T-shaped cross section, one end of the T-shaped cross section being open to receive a weight having a groove complementary to the T-shaped edge, a transverse opening through the member adjacent the T-shaped cross section, a plate arranged to be placed in said opening to retain a weight on the T-shaped edge of the support, and means for removably securing the plate in place.

8. A counterweight support for use on shafts in well pumping apparatus comprising a unitary arm member provided with a transverse hole for mounting it on a shaft, the opposite edges of the arm being formed in T-shaped cross section, one end of the T-shaped edges being open to receive weights having grooves complementary to the T-shaped edge, transverse openings through the arm adjacent the T-shaped cross sections, plates arranged to be placed in said openings to retain the weights on the T-shaped edges of the arm, and means for removably securing the plates in place.

9. A counterweight support for use on shafts in well pumping apparatus comprising a unitary sector provided with a transverse hole for mounting it on a shaft, the arcuate edge of the sector being formed in a T-shaped cross section, the ends of said arcuate edge of the sector being open to receive weights having a groove complementary to the T-shaped edge, transverse openings through the sector adjacent the ends of the arcuate edge, plates arranged to be placed in said openings to retain a weight on the T-shaped edge of the sector, and means for removably securing the plates in place.

10. A counterweight for use on a support attached to the shaft of well pumping apparatus comprising a unitary member having a slot along one edge thereof, parallel grooves in the sides of the slot facing one another and forming a T-shaped opening for receiving a complementary edge portion of a support, a bearing surface in the slot, a wedge block movable along the bearing surface and having a support-engaging surface, and means for operating the wedge block to move said surface into and out of the engaging position.

11. A counterweight for use on a support attached to the shaft of well pumping apparatus comprising a unitary member having a slot along one edge thereof, parallel grooves in the sides of the slot facing one another and forming a T-shaped opening for receiving a complementary edge portion of a support, a bearing surface in the slot, a wedge block movable along the bearing surface and having a support-engaging surface, means for operating the wedge block to move said surface into and out of the engaging position, and means for locking the wedge block-operating means.

12. In a counterweight device the combination of a support member arranged to be mounted on a shaft, a counterweight member, one of said members having an extended head of T-shaped cross section, the other member having an extended slot of T-shaped cross section complementary to said head, the head and the slot being arranged to interengage for slidably supporting the weight on the support, and wedge means carried by one of said members and arranged to engage the other member for securing the weight in any desired position relative to the support.

13. In a counterweight device the combination of a support member arranged to be mounted on a shaft, a counterweight member, one of said members having an extended head of T-shaped cross section, the other member having an extended slot of T-shaped cross section complementary to said head, the head and the slot being arranged to interengage for slidably supporting

the weight on the support, a pair of wedge blocks carried by one of said members and arranged to engage the other member for securing the weight in any desired position relative to the support, means for moving the wedge blocks simultaneously into engagement, and means for locking said wedge block moving means.

14. In a counterweight device, the combination of an arcuate support arranged to be mounted on a shaft and having a T-shaped perimeter, a weight having inturned flanges arranged to fit over the T-shaped perimeter to slidably support the weight, and a wedge movable into engagement between the weight and the support for securing the weight at any desired position relative to the support.

15. In a counterweight device, the combination of a support arranged to be mounted on the shaft, a counterweight, means interengaging the weight and the support for slidably carrying the weight on the support, a slot longitudinally of the edge of the weight adjacent the support and having an abutting surface adjacent each end thereof, a pair of blocks slidably supported in said slot between the abutments, each block having surfaces which mate in wedging engagement between the weight and the support for locking the weight in any desired position, and means engaging said blocks and normally operable to simultaneously move the blocks either toward or away from each other, said means locking the blocks when diverged against the abutments and wedging the blocks in tight engagement between the support and the weight when converged, the block having the least resistance to movement from wedging engagement employing the other block as the point of reaction for moving it to the adjacent abutment whereupon it engages said abutment and transfers the point of reaction thereto for moving the other block out of wedging engagement.

16. In a counterweight device, the combination of a support arranged to be mounted on a shaft, a counterweight, means interengaging the weight and the support for slidably carrying the weight on the support, wedge means independent of said first mentioned means arranged to engage between the weight and the support for securing the weight in any desired position relative to the support, and a screw for adjusting the wedge means, said screw being free of contact with the counterweight.

17. In a counterweight device, the combination of a support arranged to be mounted on a shaft, a counterweight, means interengaging the weight and the support for slidably carrying the weight on the support, wedge blocks independent of said first mentioned means arranged to engage between the weight and the support for securing the weight at any desired position relative to the support, and a screw for adjusting said wedge blocks, said screw being wholly supported by said wedge blocks.

18. In a counterweight device the combination of a support member arranged to be mounted on a shaft, a counterweight member, one of said members having an extended head of T-shaped cross section, the other member having an extended slot of T-shaped cross section complementary to said head, the head and the slot being arranged to interengage for slidably supporting the weight on the support, and means movable longitudinally of said head and slot to engage and fix the counterweight member against movement relative to the support.

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