

June 14, 1932.

D. S. FAULKNER ET AL

1,863,401

ROTARY DRAWWORKS

Original Filed June 21, 1926 3 Sheets-Sheet 1

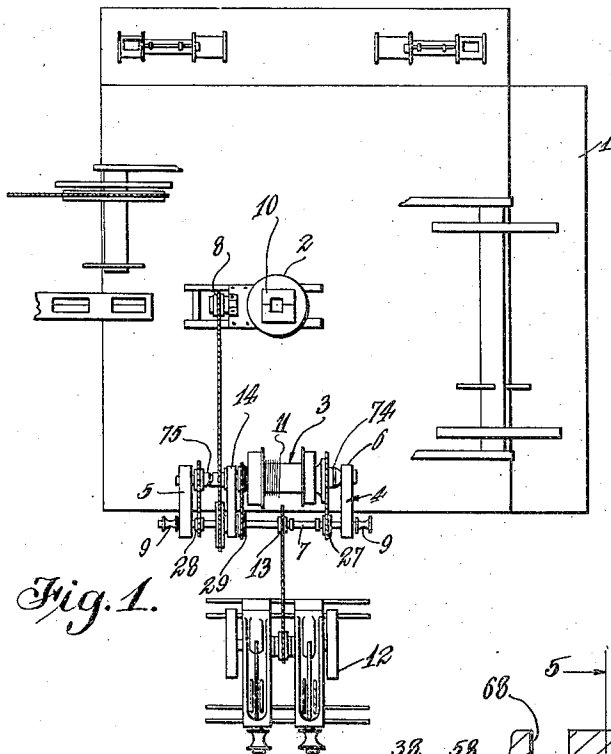


Fig. 1.

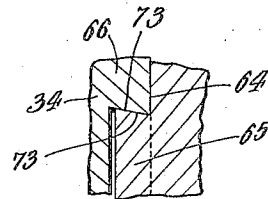


Fig. 6.

Fig. 5.

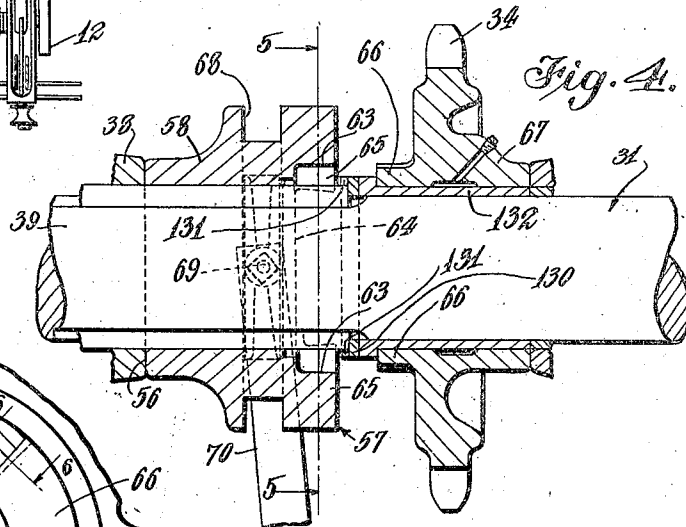
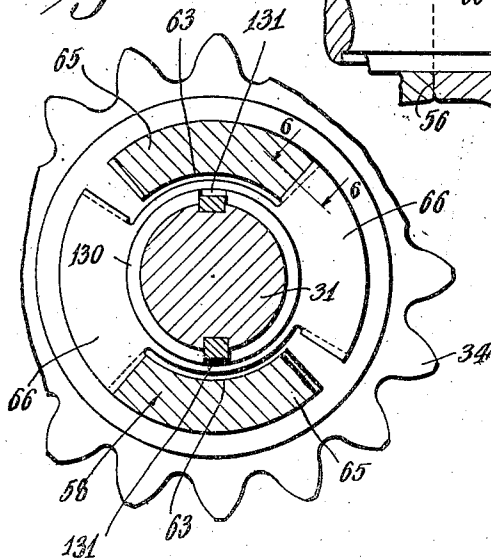


Fig. 4.

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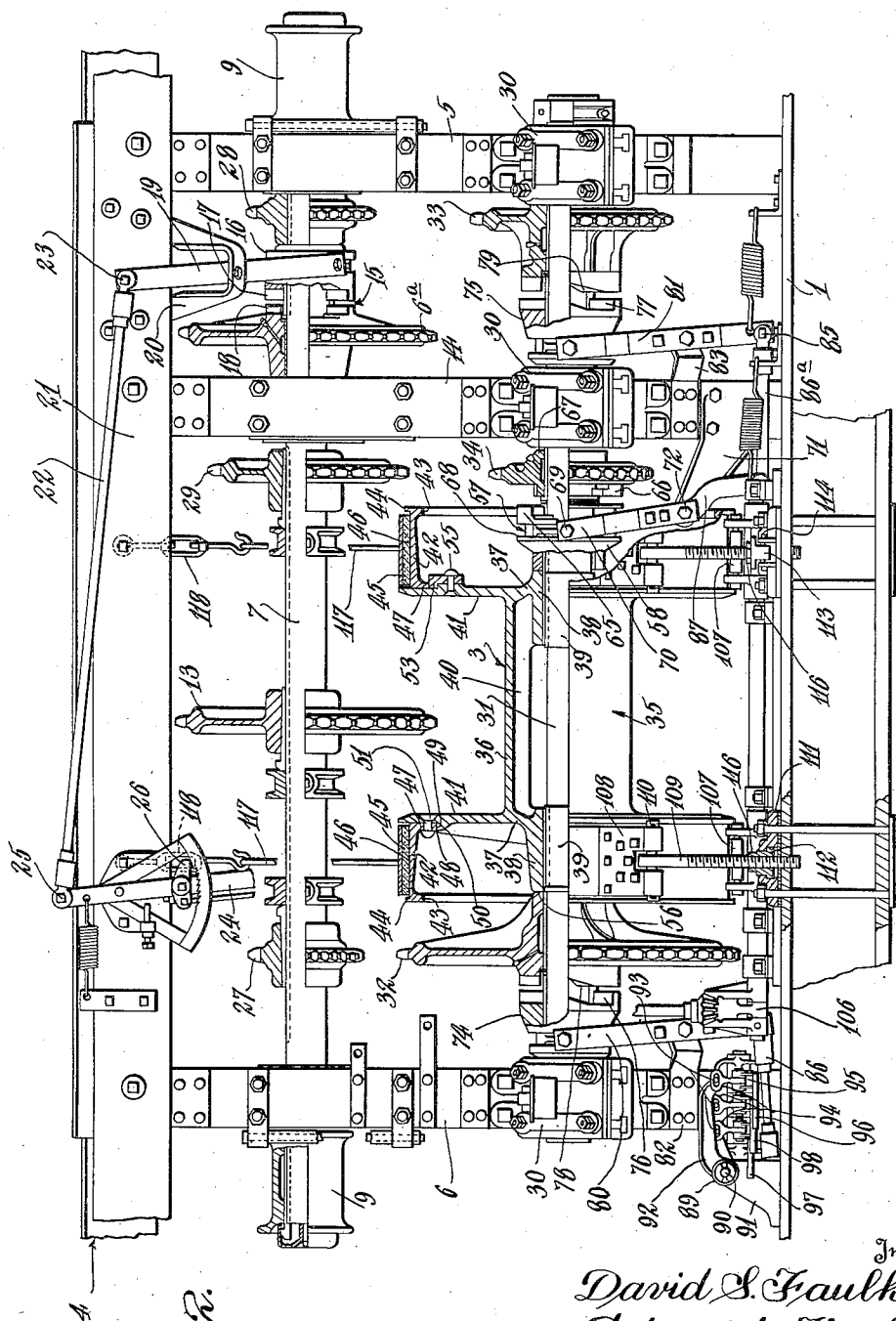
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ROTARY DRAWWORKS

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3 Sheets-Sheet 2



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ROTARY DRAWWORKS

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3 Sheets-Sheet 3

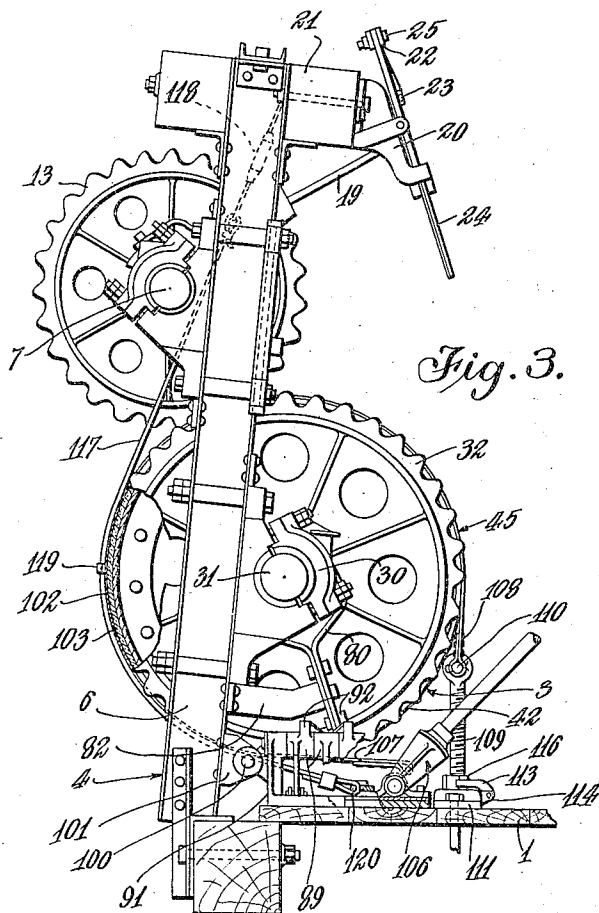


Fig. 3.

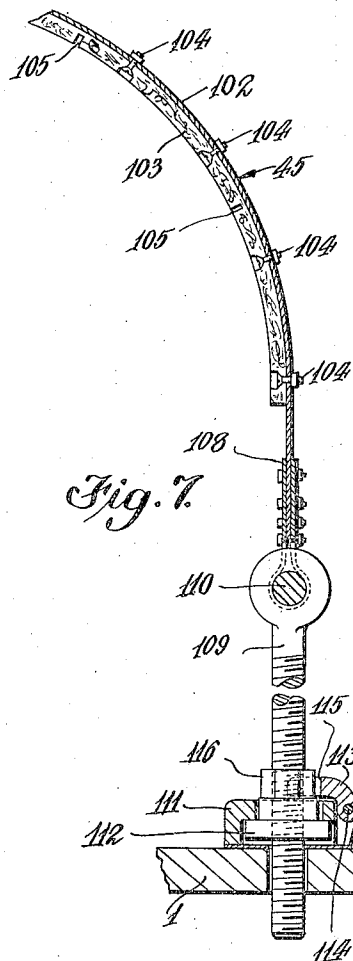


Fig. 7.

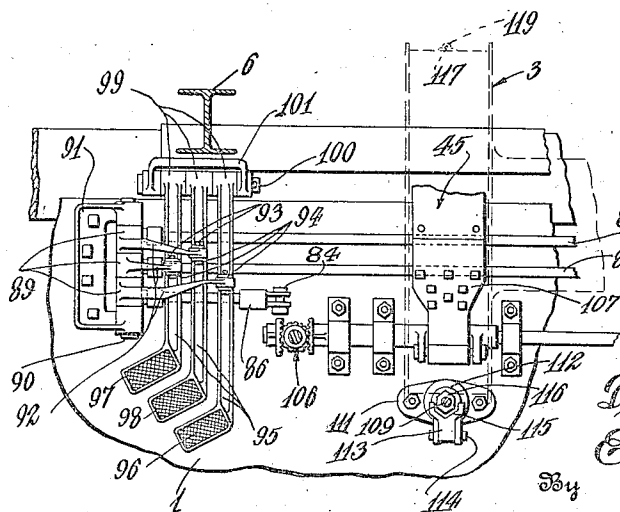


Fig. 8.

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UNITED STATES PATENT OFFICE

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ROTARY DRAWWORKS

Original application filed June 21, 1926, Serial No. 117,322. Divided and this application filed November 9, 1927. Serial No. 232,084.

This invention relates to a rotary draw-works such as is employed in the rotary process of drilling wells.

This application is a division of our co-
pending application for rotary drawworks,
filed June 21, 1926, Serial No. 117,322.

The principal object of this invention is to provide a rotary drawworks in which the distance between the drawworks posts is maintained at a minimum and which draw-
works includes a drum of relatively large size, and which drum is constructed of a spool having integral flanges and hub portions and to which spool forged brake rims are secured.

Another object of this invention is to provide a three speed rotary drawworks in which the rotary drum is preferably adapted to be rigidly secured to the drum shaft, and which drum is constructed of a spool having rolled forged brake rims secured thereto and upon which brake rims brake bands of novel construction are positioned and held equally spaced or positioned upon the said brake rims by means of cables secured to the rotary drawworks beam and to the floor of the well derrick.

Another object of this invention is to provide a third speed rotary drawworks in which clutches are provided for releasably clutching the speed sprockets to the drum shaft and in which drawworks construction, novel control means are provided for the actuation and control of the said clutches.

Another object of this invention is to provide a rotary drawworks drum construction in which means are provided for securing the cable which is wound upon the drum firmly in position to the brake flange so as to avoid the possibility of breaking the line loose from the drum and wear upon the end of the line where the same is secured.

Other objects and advantages of this invention will be apparent from the following detailed description of a preferred embodiment thereof, as illustrated in the accompanying drawings, in which drawings:

Figure 1 is a diagrammatic top plan view of a well derrick illustrating a rotary draw-works as embodying this invention as positioned therein.

Figure 2 is a side elevation partly in vertical mid-section of a rotary drawworks embodying this invention.

Figure 3 is an end elevation thereof, illustrating the low speed sprocket as broken away to illustrate the forged brake rim construction and brake bands mounted thereon.

Figure 4 is a fragmental sectional front elevation illustrating the third speed clutch mechanism embodied in this invention as illustrating the same as mounted upon a fragment of the drum shaft.

Figure 5 is an end elevation thereof, taken substantially on the line 5—5 of Figure 4.

Figure 6 is a fragmental sectional view illustrating the clutch faces of the third speed clutch mechanism illustrated in Figure 4.

Figure 7 is a detached fragmental view of a brake band construction embodied in this invention and illustrating the brake securing means as provided for securing the dead end of the brake bands embodied in this invention.

Figure 8 is a fragmental top plan view illustrating the unitary control supporting mechanism for the controls for the clutch means for each of the three speed clutches of the rotary drawworks embodied in this invention.

In the preferred embodiment of this invention, illustrated in the accompanying drawings, 1 illustrates the floor of the well derrick. Mounted in the floor of the derrick is a rotary drilling machine 2 which is operated for the purpose of rotating the rotary drill stem (not shown), to the end of which the drilling bit (likewise not shown) is secured for drilling the hole in the ground to the depth required or desired. The rotary drill stem is supported upon a hydraulic swivel, which is likewise not shown but which is well understood in the art, from or by a cable which passes over the crown block of the derrick and is wound upon the drum 3 of the rotary drawworks 4 which is mounted upon the derrick floor 1 in substantially the position illustrated in Figure 1.

It is essential that the drawworks 4 be as compact as possible, that is, that the dis-

tance between the outer posts 5 and 6 thereof be maintained at a minimum so that the rotary drive sprocket 6a, which is carried upon the line shaft 7 of the rotary drawworks 4 will align with the drive sprocket 8 of the rotary drilling machine or apparatus 2, and also so that the catheads 9 of the rotary drawworks 4 will not be extended too far from alignment with the table 10 of the rotary machine 2, as the catheads 9 are employed with a cat line in a manner well understood in the art for operating the tongs and like devices as used for the screwing up and unscrewing of the drill stem sections and for like purposes during the rotary process of drilling.

It is also essential in a rotary drawworks that the line drum 3 thereof be in position so as to maintain the cable 11 thereof in approximate alignment with the crown block sheave over which the same is passed.

In the drilling of deep wells, particularly wells of five thousand feet in depth or over, it is particularly desirable that the drum 3 be not only of increased length between the flanges thereof, but that the diameter of the spool of the drum 3 be large so as to prevent variation of the speed of travel of the line 11 which is wound thereon as the said line is coiled upon the said spool. The increasing depth of wells, of course, necessitates the provision of increased drum area for winding of the line cable and this increased demand for length of the drum 3 must not require an increased spreading of the posts 5 and 6 of the drawworks 4. In order to permit wide variation of operation of the rotary drawworks, according to the conditions met during the drilling of the well, it is preferable that the drawworks be provided with considerable speed variation for driving the drum 3. For this purpose, the drawworks is provided with three speeds, any one of which may be operated to drive the drum 3. The line shaft 7 of the rotary drawworks 4 is driven by means of a motor or engine 12 which is positioned exteriorly of the derrick 1 and is connected through a chain drive with a sprocket 13 which is rigidly secured to the line shaft 7.

The line shaft 7 is journaled in bearings which are secured to the end posts 5 and 6 and the third post 14 of the drawworks 4. The rotary drive sprocket 6a is loosely journaled upon the shaft 7 and is preferably provided with a jaw-clutch 15 for releasably engaging the sprocket 6a with the line shaft 7 when it is desired to operate the rotary machine 2, and which sprocket 6a may be disengaged from the line shaft 7 when it is desired to operate the rotary drum 3 for hoisting or lowering the drill stem into the well hole being formed. The jaw-clutch 15 may be of any desired or preferred construction and is herein illustrated as comprising a clutch col-

lar 16 which is slidably keyed to the shaft 7 so as to permit longitudinal movement of the collar 16 on the shaft 7 and so as to prevent rotation of the collar 16 relative to the shaft 7 so that the jaw engaging face 17 of the clutch collar 16 may be moved into engagement with the jaw clutch engaging face 18 which is preferably formed integral with the hub of the sprocket 6a. The collar 16 has an annular groove formed therein into which pins carried by the fork 19 extend for sliding the collar 16 on the said shaft 7. The fork 19 is pivotally supported by means of a bracket 20, which bracket 20 is secured to the beam 21 which connects the posts 5, 6, and 14 of the drawworks at their upper end. An actuating rod 22 is secured to the fork 19 at a pin 23 and is secured to an actuating lever 24 at its opposite end at a pin 25. A pawl and ratchet latch means 26 are provided for latching the clutch collar 16 into driving engagement with the sprocket 6a and the pawl and ratchet means and actuating lever 24 are positioned at the left of the drawworks, as illustrated in Figure 3, so as to permit easy access of the operator of the drawworks from such position. Keyed to the line shaft 7 is a low speed sprocket 27, an intermediate speed sprocket 28 and a high or third speed sprocket 29.

Mounted below the line shaft 7 and in bearings 30 is a drum shaft 31, upon which drum shaft 31 low, intermediate and third speed sprockets 32, 33 and 34 are journaled, each of which sprockets is provided with clutch means for releasably engaging the same with the drum shaft 31, as will hereinafter be described. The drum 3 is keyed to the drum shaft 31 and is preferably constructed of a spool 35, which spool 35 is preferably constructed of a cylindrical portion 36 which has, at its opposite end, downwardly inclined integral flanges 37 which are formed integral with the oppositely extending hubs 38 which are keyed to the portions 39 of increased diameter of the drum shaft 31. A plurality of webs 40 are cast integral with the cylindrical portion 36 of the drum 3 for removing the same. Formed integral with the spool 35 are outwardly extending annular flanges 41 which are formed at the opposite end of the cylindrical portion 36.

Forged rolled brake rims 42 are provided, which forged rolled brake rims are preferably composed of a single portion of steel forged while hot in a manner similar to the forging of rims for machine car wheels and the like and during the forging are rolled at their outer edge with a downwardly extending flange 43 which provides a cooling solution retaining rim for maintaining a cooling solution within the brake rim for cooling the same during braking operations. The outer edge of the rim 42 is also formed with an upwardly extending flange 44 which pro-

vides a retaining rim for retaining the brake band 45 against lateral movement upon the rim 42. The brake rim 44 provides a braking surface 46 which is preferably hardened by any of the well known processes and the rim 42 is formed at its inner end with an inwardly extending annular flange 47, which annular flange 47 provides an edge shoulder 48 which fits the edge shoulder 49 formed by the annular abutment 50 which is formed integral with the flanges 41 of the spool 35. Rivets 51 are counter-sunk in the flanges 41 and extend through the annular flange 47 and are riveted over within the brake rims 42 so that a substantially flat surface is maintained at the interior of the spool flanges 41. The annular flange 47 of the brake rim 42 is cut away at a plurality of points to accommodate keys 53 which fit within the cut away recesses and which are secured to the flanges 41. The keys 53 are preferably secured to the flanges 41 by means of counter-sunk rivets 55. The rivets 51 and 55 are preferably cold-pressed into position by means of a jack interposed between the flanges 41 and their inner ends are then heated by means of an acetylene torch, or the like, and riveted over by the use of a hydraulic riveting machine.

The hub 38 at the left-hand end of the spool 35 is formed so as to extend into the interior of the forged brake rim 52 and of sufficient length or extent to provide a firm bearing support for the drum 3 at that end and extends into the drum 42 so as to engage the end face 56 of the low speed sprocket 32 upon the drum shaft 31. In order to accommodate the clutch 57 of the third speed sprocket 34, the hub 38 formed at the right end of the spool 35 extends inwardly into the interior of the cylindrical portion 36 of the spool 35 and extends only slightly into the interior of the right hand rim 42 and is of sufficient extent to provide a firm bearing support at this end of the drum 3. This hub 38 at the right hand end of the spool 35 extends inwardly into position as before described, so as to permit the mounting of the clutch collar 58 on the line shaft 31 for releasably securing the third speed sprocket 34 to the shaft 31.

The clutch means provided for clutching the third speed sprocket 34 to the drum shaft 31 is preferably composed of a clutch collar 58 which is keyed to the shaft 31 so as to be longitudinally slidable thereon and is provided at its end engaging face with a cylindrical cut away recess 63 which has formed on its inner face 64 a plurality of clutch projections 65 which are adapted to engage the clutch segments 66 which are formed integral with the hub 67 of the third speed sprocket 34, which third speed sprocket 34 is loosely journaled upon the shaft 31 and is maintained against endwise motion at its outer end by engagement with the end of the bearing 30

which is secured to the third post 14 of the drawworks and in which shaft 31 is journaled. The collar 58 has an annular recess 68 formed therein into which pins 69, carried by the fork 70, project for sliding the clutch collar 58 longitudinally along the shaft 31. The fork 70 is pivotally secured to a bracket 71 at a pin 72 and which bracket 71 is secured to the third post 14 of the drawworks. The engaging clutch segments 65 and 66 of the collar 58 and sprocket 34, respectively, are formed with tapered engaging edges 73, as illustrated in Figure 6.

Clutch collars 74 and 75, having tapered engaging faces 76 and 77, are keyed to the drum shaft 31 in position to engage the tapered engaging faces 78 and 79 of the low and second speed sprockets 32 and 33, respectively. The clutch actuating yokes 80 and 81 for these aforesaid clutch collars are pivotally supported by means of brackets 82 and 83, respectively, which are secured to the respective posts 5 and 14 of the drawworks. The yokes 80 and 81 are pivotally secured at pins 84 and 85, respectively, to actuating rods 86 and 86a which extend longitudinally of the drawworks to the left hand end thereof. The fork 70 for the third speed clutch collar 58 is rigidly secured to a curved actuating lever 87 and the curved actuating lever 87 is secured to the floor 1 of the derrick by means of a bracket similar to the bracket 84 and is secured to an actuating rod 88 which likewise extends longitudinally of the drawworks to the left end thereof.

The actuating rods 86 and 88 are secured to downwardly extending projections which are formed integral with the collars 89 which are mounted upon a shaft 90 which is supported in a bracket 91 secured to the derrick floor. The collars 90 at their opposite faces have arms 92 formed integral therewith so that the collars 89 with the arms 92 and the downwardly projecting arm which connect with the actuating rods 86 and 88 form bearing crank levers which are secured at their inner ends at pins 93 which are passed through ears 94 formed integral with foot actuating pedals 95 so that as the foot actuating pedals 95 are depressed, the rods 86 and 88 will be actuated to engage or disengage the respective clutches for the shaft 2 or third speed of the rotary drawworks, as desired by the operator.

As illustrated, the pedal 96 is the first speed control, the pedal 97 is the second speed control, and the intermediate pedal 98, the third speed control. The pedals at their opposite ends are formed with hubs 99 which are journaled upon a pin 100 mounted in a bracket 101 which is secured to the floor 1 of the derrick. This manner of bringing on the speed controls to a common point and permitting their actuation by means of the feet of the operator is an important feature

of this invention as it enables a more easy, safe, and accurate control of the drawworks and so centralizes the controls.

The brake bands 45 which are mounted upon the brake rims 42 are preferably constructed of a band 102, to which band 102 the brake lining 103 is secured by means of counter-sunk bolts or rivets 104 which are countersunk in the brake lining 103 and extend through the brake band 102. The brake lining 103 is sawed at a plurality of points 105 so as to enable the same to more accurately follow the contour of the brake rims 42. Any suitable or desirable form of brake actuating means 106, as is well understood in the art, may be provided for actuating the brake bands 45 and the live end 107 of the brake band 45 is secured to this brake actuating means 106 in any desired or preferred manner. The dead end 108 of the brake bands 45 is secured to an eye bolt 109 in any desired or preferred manner, as illustrated at 110, and extends through the floor 1 of the derrick through a bracket 111 which is secured to the floor 1 and within which a collar 112 is mounted, and which collar 112 is screw-threaded to the end of the eye-bolt 109 so as to adjustably and firmly secure the dead end 108 of the brake bands 45. Lock means are provided for locking the collar 112 in the adjusted position, which lock means preferably comprise a lock link 113 which is pivotally secured at a pin 114 supported by the bracket 111 and which lock link 113 has a locking recess 115 formed at its engaging end of substantially the shape to engage the hexagonal head 116 of the collar 112 so as to prevent rotation of the collar 112 on the eye bolt 109.

Means are provided for supporting the brake bands 45 so that the same will not drag upon the brake rims 42 when not in use, which means preferably comprise a cable 117 which is secured to a turn-buckle 118, and which turn-buckle 118 is at its opposite end secured to the beam 21 of the rotary drawworks. The cable 117 passes through a clip 119 secured to the rear face of the brake band 102 and extends around the brake band 102 and is secured to the derrick floor at 120 so as to support and hold up the brake band 45 when it is not desired to operate the same. The turn-buckle 118 permits accurate adjustment of this holding means so as to adjust the non-operating position of the brake band 45.

In order to lock the assembly of the clutch collar 58 and sprocket 34 on the shaft 31 between the hub 38 of the drum 3 and the post 14, a lock washer 130 is provided which engages the key end of the keys on which the collar 58 is splined. The lock washer 130 is provided with recesses 131 into which said keys fit. The washer 130 engages the sprocket assembly 66 at the end of the bearing

sleeve 132 on which the sprocket is journaled on the shaft 31. The hub 67 of sprocket 34 abuts the bearing assembly in which shaft 31 is journaled on the post 14. The washer 130 is held stationary by the keys fitting in recesses 131 and thereby provides a thrust bearing washer for the sprocket 34, maintaining said sprocket 34 in alignment with its driving sprocket 29.

Having fully described a preferred embodiment of our invention, it is to be understood that we do not wish to be limited to the exact details herein set forth, which may obviously be varied without departing from the spirit of our invention, as set forth in the appended claims.

We claim:

1. In combination with a rotary drawworks comprising a spool, a drum shaft, hubs formed integral with the spool for securing the said spool to the shaft, one of which hubs extends inwardly into the said spool, forged rolled brake rims secured to the said spool, a clutch collar mounted on the said shaft, substantially in engagement with the end face of the said hub and within the interior of one of the forged rolled brake rims secured to the said spool, a clutch sprocket journaled on the said shaft, and lever means extending into the interior of the said forged rolled brake rims for moving the said clutch collar longitudinally on the said drum shaft for engagement with the said sprocket.

2. In a rotary drawworks, the combination of a plurality of spaced posts, a line shaft journaled in bearings secured to the posts; a drum shaft journaled in bearings secured to the said posts below and in advance of the line shaft, means for driving the line shaft, first, second, and third speed drive means between the line shaft and the drum shaft, separate means on the drum shaft for engaging either of the said speed drive means with the said drum shaft, a control lever for each of said engaging means, an actuating rod secured to each of the said actuating levers and extending longitudinally of the drum shaft, and each of the said actuating rods being provided with an actuating pedal mounted in a common bracket secured in position at one end of the drawworks.

3. In a rotary drawworks, the combination of a supporting structure including spaced posts, a line shaft journaled in bearings secured to the drawworks posts, a drum shaft journaled in bearings below and in advance of the line shaft, a drum mounted on the drum shaft, forged rolled brake rims secured to the drums at the opposite ends thereof, a third speed drive sprocket journaled on the drum shaft adjacent the third drawworks post, the said drum having a hub which extends inwardly into the spool thereof, a clutch collar mounted on the drum shaft

between the end face of the said spool and the third speed drive sprocket substantially in engagement with the end face of the said hub when moved to the non-engaging position with the said third speed sprocket, and means secured to the said clutch collar and extending into the said forged rolled brake rims for moving the said collar longitudinally on the said drum shaft into engagement with the said third speed sprocket.

4. In a rotary drawworks, the combination of a line shaft journaled in bearings secured to three spaced drawworks posts, a drum shaft journaled in bearings secured to the said posts, a drum mounted on the said shaft, brake rims secured to and extending outwardly from said drum, a low speed drive connection between the line shaft and drum shaft, a second speed drive connection between the line shaft and drum shaft, and a third speed drive connection adjacent the third post of the drawworks and comprising a sprocket rigidly secured to the line shaft, a sprocket journaled on the drum shaft adjacent the bearing mounted upon the third post, a clutch collar rigidly secured in slidable relation on the drum shaft adjacent the drum, the clutch collar having a cylindrical cut away recess within which a plurality of cut projections are formed, the sprocket hub having a plurality of clutch segments formed thereon over which the said clutch collar projections are adapted to slide for securing the said sprocket to the said shaft, and a forked actuating lever secured to the clutch collar and extending within one of the brake rims secured to the said drum.

5. In a rotary drawworks, the combination of spaced posts, a drum shaft journaled in bearings on said posts, a drum secured to said shaft, a sprocket journaled on the shaft, a clutch collar splined to said shaft, the clutch collar and sprocket being mounted on said shaft between the end of said drum and its adjacent post, a lock washer interposed between the clutch collar and sprocket to hold said sprocket from moving longitudinally of said shaft and from said post, and means for driving said sprocket.

6. In a rotary drawworks, the combination of spaced posts, a drum shaft journaled in bearings on said posts, a drum secured to said shaft, a low speed drive connection to said shaft at one end of the drum, and a higher speed drive connection to said shaft at the other end of said drum, the said higher speed drive connection including a sprocket journaled on said shaft, a clutch collar splined on said shaft, and a lock washer secured against rotation on said shaft and holding said sprocket against movement away from said post.

7. In a rotary drawworks, the combination of a pair of spaced posts, a shaft rotatably supported by said posts, a drum secured to

said shaft, a low speed drive connection located between one end of the shaft and its adjacent post, a higher speed drive connection located between the other end of said drum and its adjacent post, the higher speed drive connection including a clutch collar, a key on which said collar is slidably mounted, a sprocket, a lock washer secured to said key between the collar and sprocket and holding said sprocket from movement away from the said post, and means for sliding said collar into clutching engagement with said sprocket.

Signed at Torrance, Calif., this 17th day of October, 1927.

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