

June 6, 1939.

J. S. MORGAN, JR

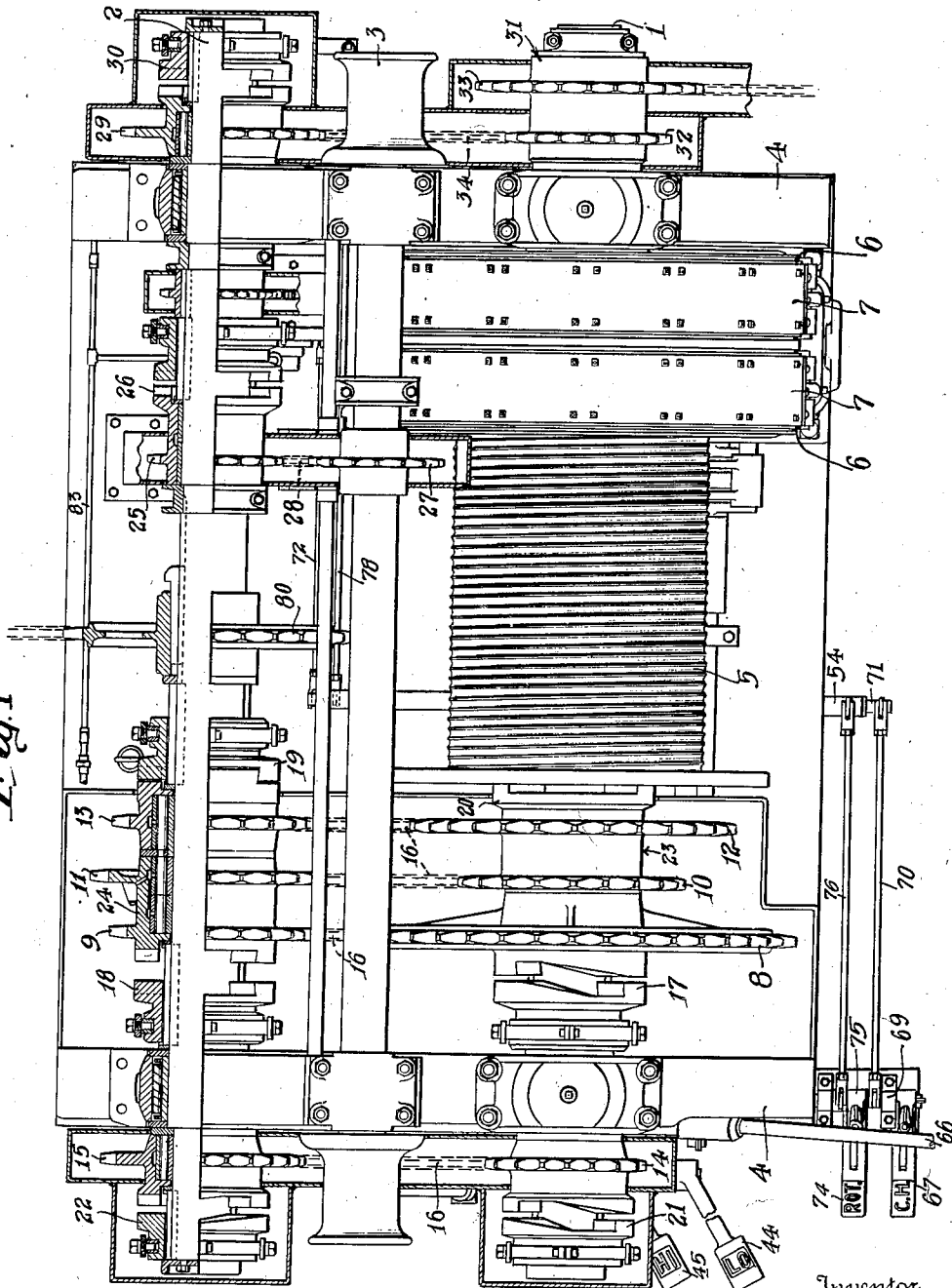
2,161,075

DRAW WORKS

Filed Dec. 21, 1935

7 Sheets-Sheet 1

Fig. 1



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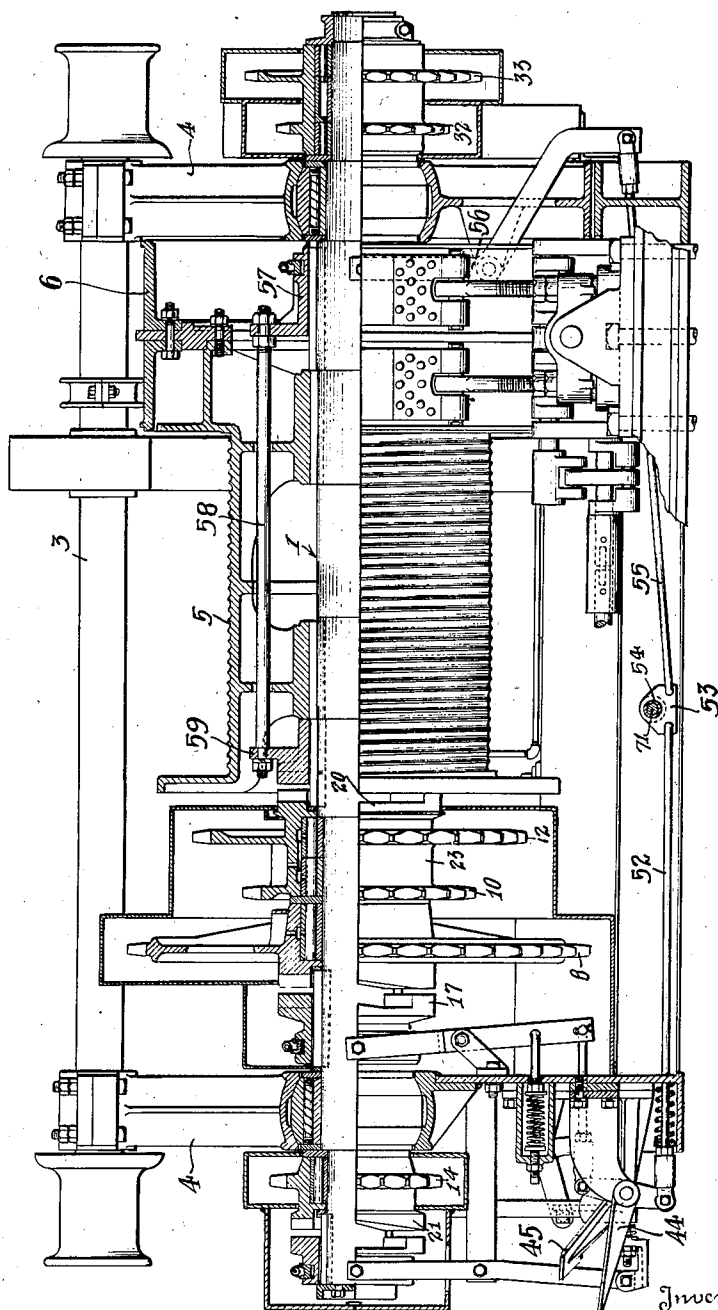
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Fig. 2



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Fig. 3

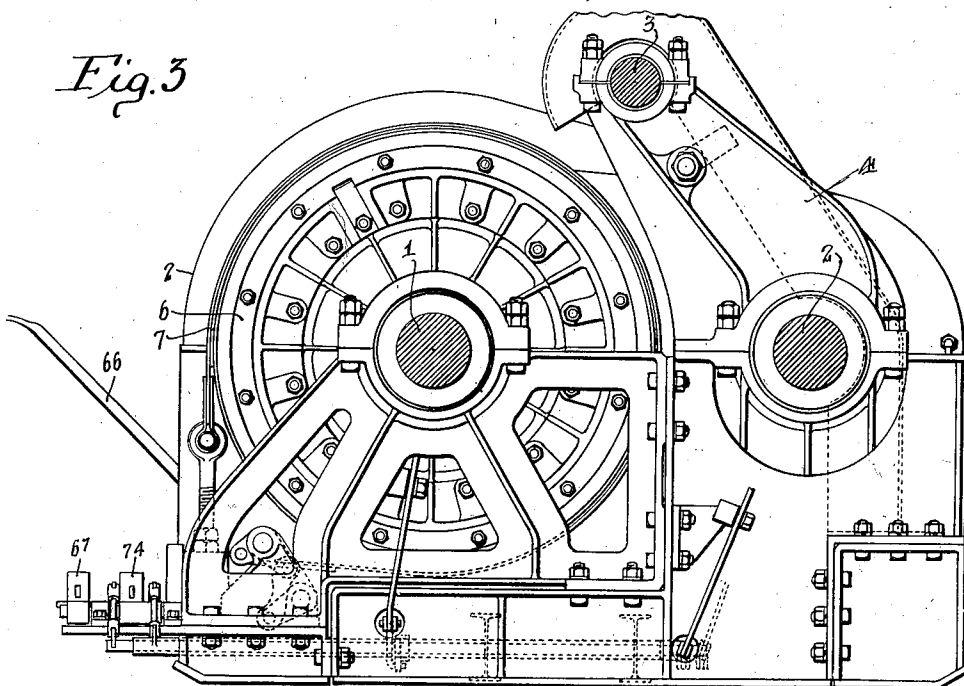
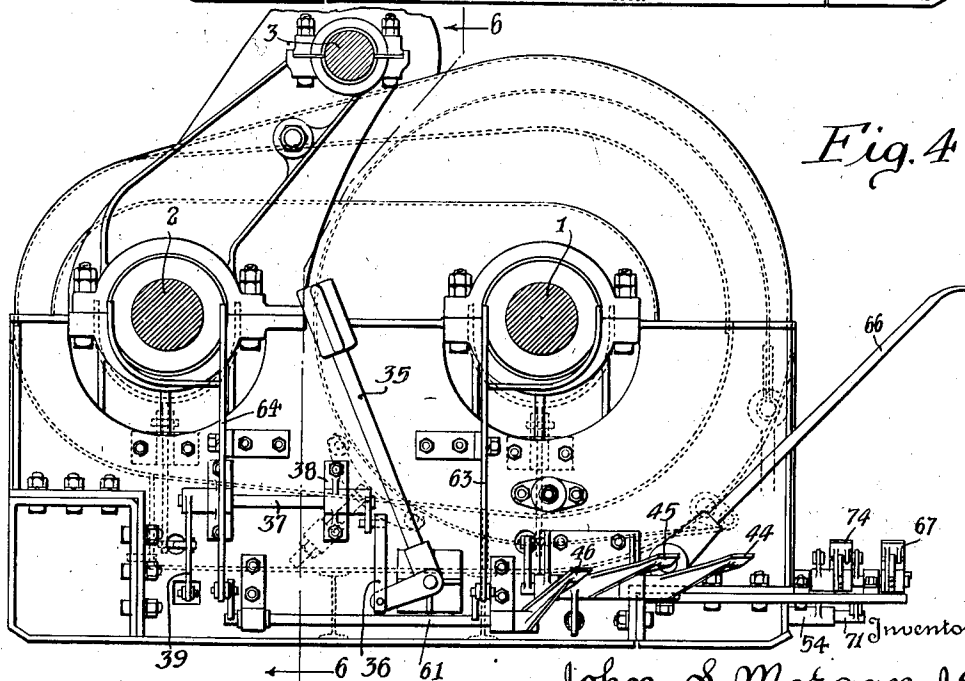


Fig. 4



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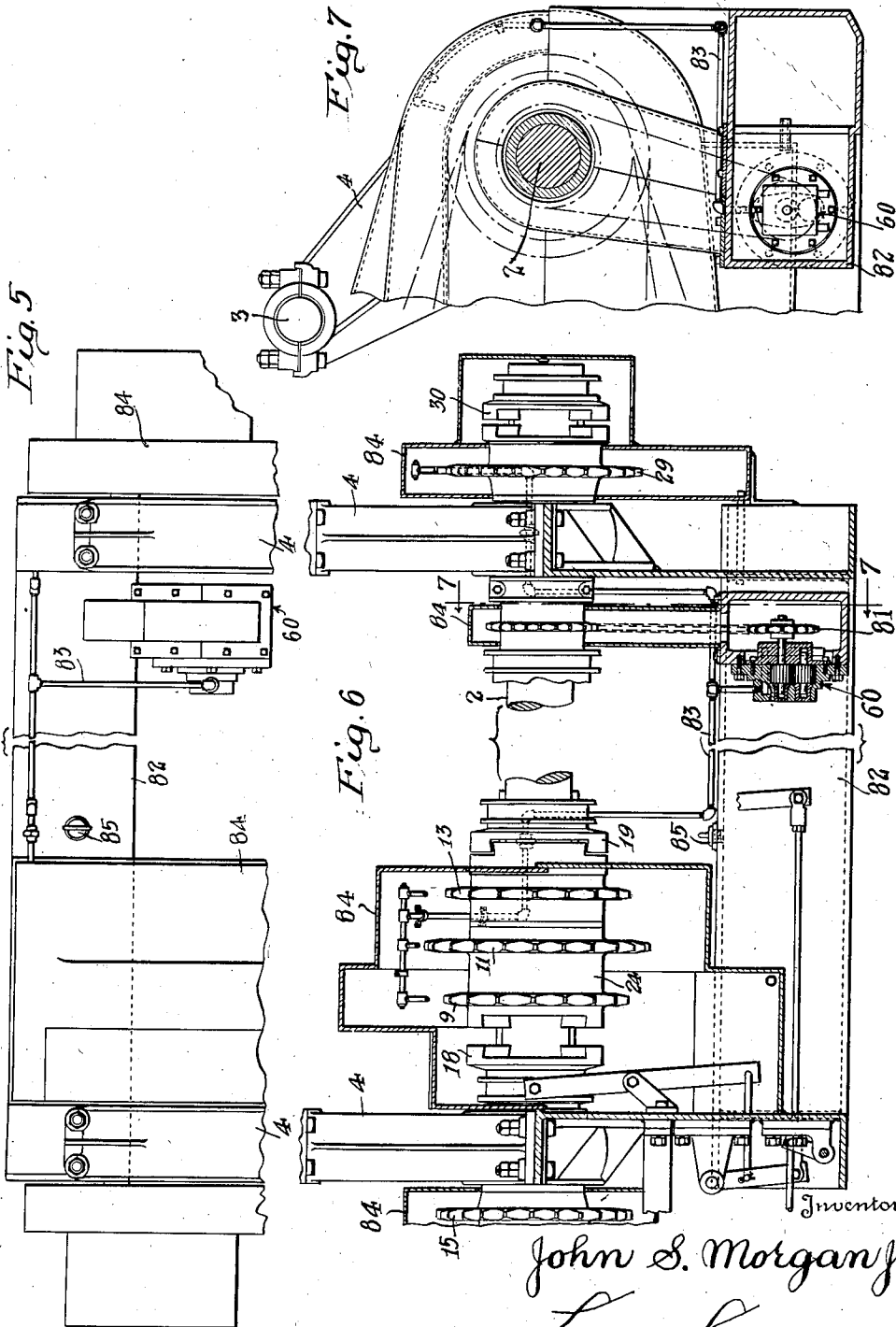
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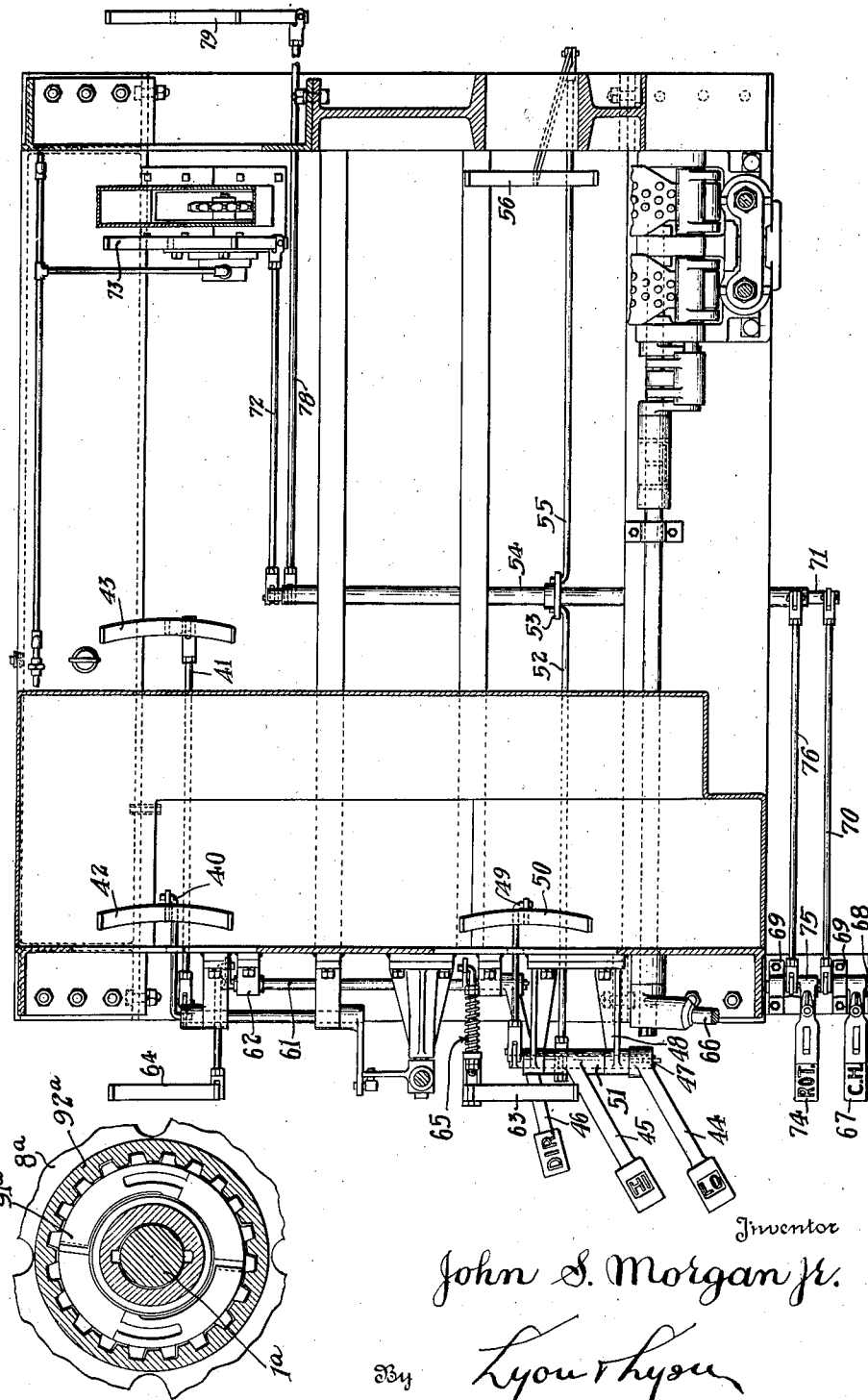
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Fig. 8

Fig. 12



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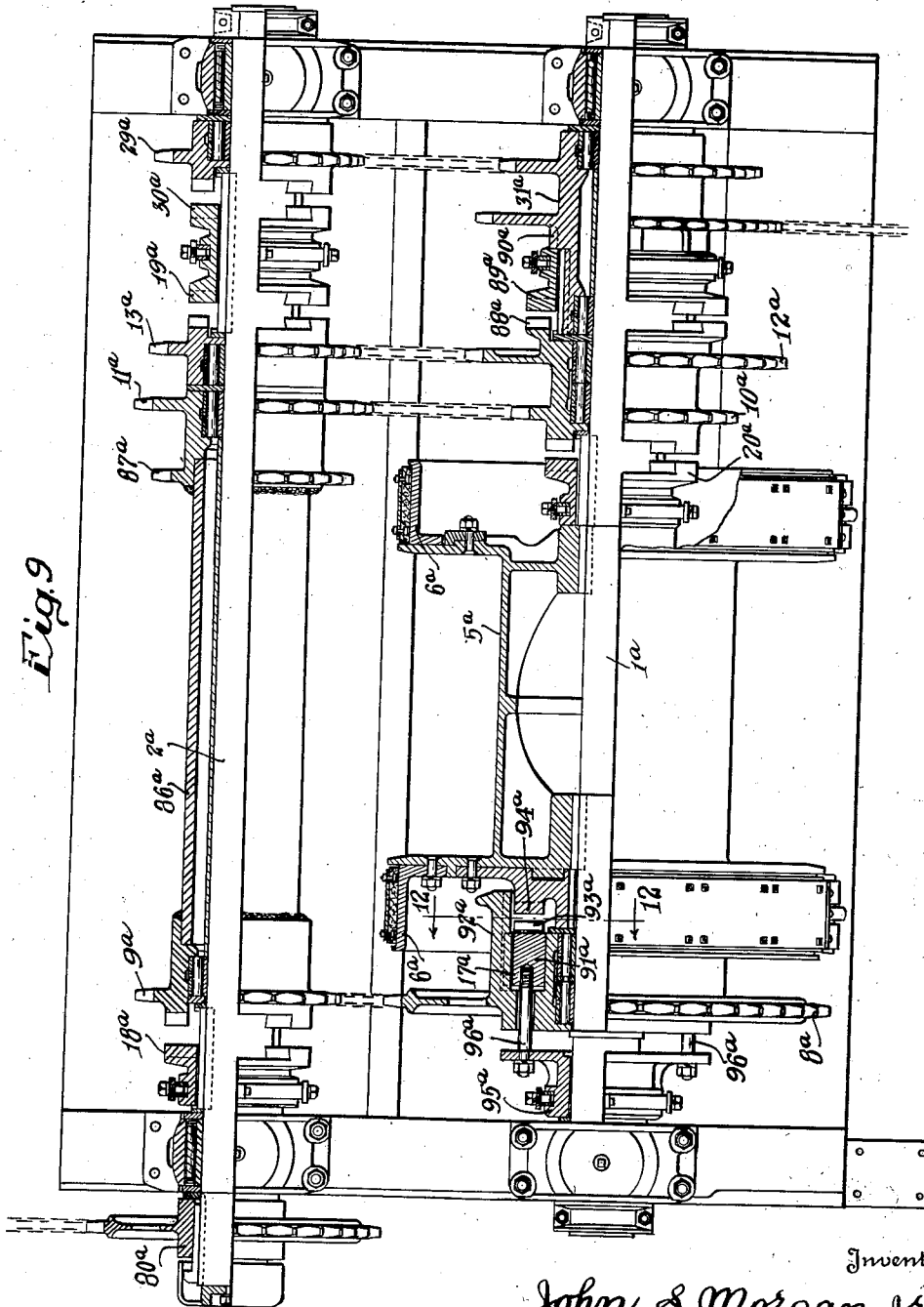
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DRAW WORKS

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7 Sheets-Sheet 6



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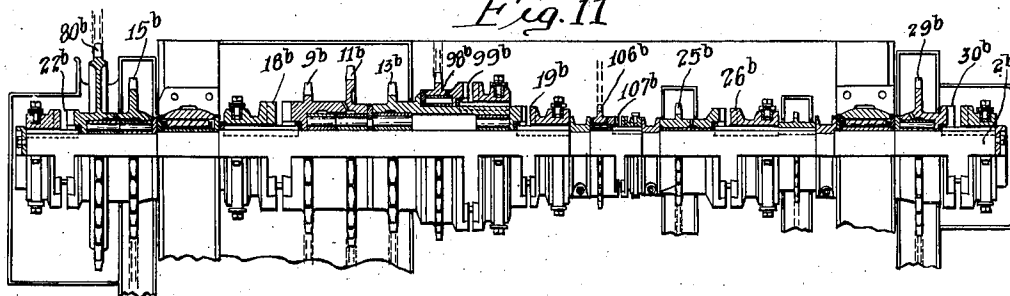
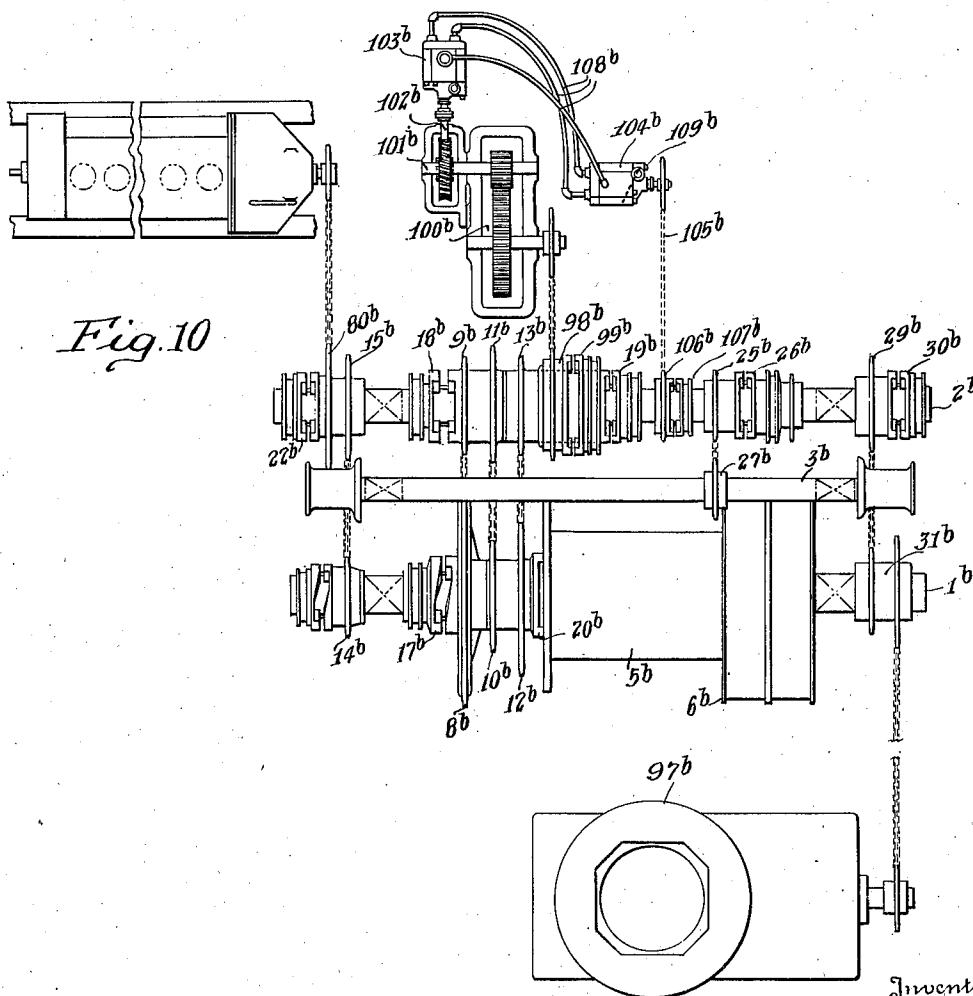
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DRAW WORKS

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7 Sheets-Sheet 7



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UNITED STATES PATENT OFFICE

2,161,075

DRAW WORKS

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by mesne assignments, to The National Supply
Company, Pittsburgh, Pa., a corporation of
Pennsylvania

Application December 21, 1935, Serial No. 55,591

5 Claims. (Cl. 255—19)

This invention relates to a rotary drawworks applicable for use in connection with drilling equipment as utilized in drilling for water, oil, or gas, and more particularly to the type of rotary drawworks employed in connection with the rotary method of drilling.

This invention is directed to an improved rotary drawworks wherein a power transmission means is employed through the medium of which it is possible to obtain a maximum number of speeds of rotation of the drum shaft while using a minimum number of transmission connections.

It is an object of this invention to provide an improved form of rotary drawworks wherein the drum shaft of the rotary drawworks may be driven at a maximum number of speeds from a power shaft through a minimum number of transmission connections.

Another object of this invention is to provide a rotary drawworks for use in connection with the rotary method of drilling wells, which includes a pair of shafts having power transmission connections between them and through which power transmission connections a maximum number of speeds may be transmitted from one shaft to the other.

Other objects and advantages of this invention it is believed will be apparent from the hereinafter contained description of the preferred embodiments of my invention.

In the drawings:

Figure 1 is a plan view partly in section of a rotary drawworks embodying my invention.

Figure 2 is a front elevation partly in section thereof.

Figure 3 is a side elevation partly in section illustrating the construction of one end frame of the rotary drawworks.

Figure 4 is a side elevation of the rotary drawworks illustrating the brake and clutch operating levers.

Figure 5 is a fragmental plan view of the rotary drawworks embodying my invention.

Figure 6 is a fragmental sectional view taken substantially on the line 6—6 of Figure 4 of the drive shaft assembly of the rotary drawworks embodying my invention.

Figure 7 is a fragmental sectional view taken substantially on the line 7—7 of Figure 6 further illustrating the drive shaft assembly.

Figure 8 is a sectional plan view of the drawworks illustrating the clutch operating foot levers.

Figure 9 is a plan view of a modified form of drawworks embodying my invention and shown partly in cross section.

Figure 10 is a diagrammatic view illustrating a further modification of the drawworks embodying my invention illustrated in connection with an improved drilling control.

Figure 11 is a partly sectioned view of the rotary drawworks drive shaft as illustrated in Figure 10.

Figure 12 is an end sectional view taken substantially on the line 12—12 of Figure 9.

In the rotary drawworks embodying my invention as shown by the form illustrated in Figures 1 to 8, inclusive, there is included a drum shaft 1, a drive shaft 2, and a cat shaft 3. The shafts 1, 2 and 3 are rotatably supported in bearings carried by end frames 4.

Mounted upon the drum shaft 1 is a drum 5 which is provided at one end with brake rims 6 over which brake bands 7 are trained. Any suitable or desirable means may be employed for tightening the brake bands 7 upon the brake rims 6, one form of which is illustrated in Figure 2.

Transmission drive connections are provided for driving the drum shaft 1 from the drive shaft 2, which transmission drive connections preferably include sprockets 8, 9, 10, 11, 12, 13, 14 and 15. These sprockets are mounted upon the drum shaft 1 and drive shaft 2 in position so that the transmission connecting members such as chains, indicated in dotted lines at 16, are trained over the respective pairs of sprockets. The sprockets as thus described are all journaled upon the shafts 1 and 3, and clutch means consisting of clutches 17, 18, 19, 20, 21 and 22, are provided for releasably clutching the sprockets to the respective shafts. The sprockets 10 and 12 are both mounted upon a sleeve 23 so that these sprockets will rotate together. Sprockets 9 and 11 are likewise mounted upon a common sleeve 24. The driving connections as thus provided from the drive shaft 2 and drum shaft 1 are: a high speed direct transmission connection as provided from the shaft 2 to the shaft 1 when the clutches 21 and 22 are engaged, and when no other clutches are engaged, provide a high speed connection wherein only a single driving chain is caused to move.

The transmission connection provided between sprockets 8, 9, 10, 11, 12 and 13, provides a means by which the shaft 3 may drive the drum shaft 1 at four independent speeds while employing only three separate transmission connections, thus providing for a maximum number of speeds of drive of the drum shaft 1 from the drive shaft 55

3 while utilizing a minimum number of drive connections.

The four speeds of drive thus transmitted from the drive shaft 3 to the drum shaft 1 are:

5 One speed is attained by the actuating of clutches 17 and 18 so that a drive is had from the shaft 2 to the shaft 1 through the sprockets 9 and 8 and connecting transmission chain 16.

10 A second speed of drive is had when clutches 19 and 20 are actuated to give a drive from the sprocket 13 through the connecting chains 16 to the driven sprocket 12 and shaft 1.

15 A third speed of drive is had when the clutches 18 and 20 are actuated so that the drive is from sprocket 11 through the chain 16 to the sprocket 10 and drum shaft 1.

20 A fourth speed of drive is had when the clutches 19 and 17 are engaged, at which time the drive is from the shaft 3 through the sprocket 13, chain 16, sprocket 12; from the sprocket 10 through chain 16 to the sprocket 11, and from the sprocket 9 through the chain 16 to the sprocket 8.

25 Means are provided for driving the cat-shaft 3 from the drive shaft 2, which means preferably includes a cat shaft drive sprocket 25 journaled on the drive shaft 2 and adapted to be releasably connected thereto by means of a cat shaft clutch 26. The cat shaft driven sprocket 27 is secured 30 to the cat shaft 3 and is connected with the driven sprocket 25 by means of a chain diagrammatically illustrated at 26.

Means are provided for driving a rotary machine (not shown) from the drive shaft 2, which 35 means preferably includes a rotary drive sprocket 29 which is journaled upon the shaft 2 and is adapted to be releasably coupled thereto by means of a rotary drive sprocket clutch 30. A double sprocket 31 is journaled upon the drum 40 shaft 1 and includes sprocket teeth 32 and 33. A chain diagrammatically illustrated at 34 connects the sprocket 29 with the double sprocket 31, and a chain extends from the teeth 33 of the double sprocket 31 forwardly to drive the rotary machine drive sprocket (not shown).

45 Means are provided for actuating the respective clutches, which means are preferably all located at the position assumed by the driller in controlling the rotary drilling apparatus. A 50 clutch lever 35 is provided for actuating the clutches 18 and 19. The clutch lever 35 is pivotally supported upon the end frame and is connected through a series of links 36 (Figure 4) to a shaft 37 supported by the end frame in 55 brackets 38. Shaft 37 is connected through a crank 39 with a pair of clutch shifter rods 40 and 41, which in turn are connected to the clutch shifter forks 42 and 43. Actuation of the clutch shifter lever 35 to the right, as viewed in Figure 4, 60 causes engagement of the clutch 18, and actuation of this lever in the opposite direction causes disengagement of the clutch 18 and engagement of the clutch 19.

Clutch pedals 44, 45 and 46 are positioned at 65 the driller's position for engaging the clutches 17, 20 and 22, respectively. The low speed clutch pedal 44 is secured to a shaft 47 carried by supporting brackets 48. The shaft 47 is connected through link 49 of the clutch shifter fork 50, 70 which engages a clutch collar of the clutch 17. The high speed clutch pedal 45 is secured to a sleeve 51 journaled on the shaft 47 and is connected by clutch shifter rod 52 to a plate 53 journaled on the sleeve 54.

75 A rod 55 is secured to the plate 53 and is con-

nected to the clutch shifter fork 56. The clutch shifter fork 56 actuates the clutch shifter collar 57. The clutch collar 57 is connected by rods 58 to the shifting clutch jaw 59 which is splined upon the drum shaft 1. The rods 58 extend 5 through the interior of the drum 5 which is splined on the drum shaft 1 and the collar 57 is mounted within the space surrounded by the brake rims 6 in order that the space between the end frames 4 of the drawworks may be decreased. 10

The direct drive pedal 46 is secured to a shaft 61 journaled in brackets 62 upon the end frame 4 and is operatively connected to the clutch shifter yokes 63 and 64 for actuating the clutches 21 and 22 into or out of engagement for estab- 15 lishing the direct drive through the sprockets 14 and 15 from the drive shaft 2 to the drive shaft 1. The clutch shifter yoke 63 is operated through a spring 65 to allow for a difference in engagement positions of the clutches 21 and 22. 20

A brake lever 66 is positioned in the driller's position to enable the driller to operate the two brake bands 7 through a lever and link system which is, as illustrated, of the type described in Patent No. 1,956,433 issued to Forrest J. Young, 25 et al.

The cat shaft pedal 67 is secured to a shaft 68 supported by brackets 69, and an actuating rod 70 is connected through a suitable lever with the shaft 68 and is likewise connected by a suit- 30 able lever with a shaft 71. An operating rod 72 connects the opposite end of the shaft 71 with the shifter yoke 73 for shifting the cat shaft clutch 26.

A rotary clutch pedal 74 is secured to a sleeve 35 75 journaled on the shaft 68 and is connected through suitable levers and the rod 76 with the sleeve 54 journaled upon the shaft 71 and through suitable levers and operating rod 78 with the rotary drive sprocket shifter fork 79 for actu- 40 ating the rotary drive sprocket clutch 30.

Mounted at any suitable point upon the drive shaft 2 is a power sprocket 80 which is connected through the use of a suitable transmission element with any desired form of prime 45 mover.

Means are provided for lubricating the transmission drives, and this means preferably includes a means of providing a continuous circulation of lubrication medium to the different 50 transmission elements and in the preferred form illustrated in the drawings includes a gear type oil pump 60 which is driven through suitable transmission connections 81 from the drive shaft 2. The pump 60 is mounted in a sump 82 formed 55 in the enclosing means by which the transmission elements of the rotary drawworks embodying my invention are preferably enclosed.

Conduits 83 extend from the gear pump 60 to deliver lubricant from the sump 82 directly over 60 each of the transmission elements. In order to maintain the transmission elements free of foreign matter, dirt, or the like, and to confine the circulated lubricant, housings 84 of any suitable form are provided for enclosing the transmission 65 elements and are so positioned as to permit the lubricant delivered from the pump 60 to the transmission elements located within the housings to be conducted back to the sump 82 so as to permit a continuous circulation of transmission 70 lubricant.

A filling opening 85 is provided in the case forming the sump 82 to permit filling of the case to the desired level with lubricant.

In the modified form of construction embody- 75

ing my invention illustrated by Figures 9 and 12, similar parts are numbered with similar numbers with the addition of an exponent "a" thereto, and in this form of construction the principal differences are found in the fact that the drum 5^a mounted upon the drum shaft 1^a is of customary construction in that it includes brake rims 6^a formed at its opposed ends. In this form of construction there is illustrated no cat shaft in the particular illustration given, but it is obvious that the cat shaft could be provided and mounted substantially as shown in connection with the modifications illustrated in Figures 1 to 8, inclusive, if desired.

The transmission connections are similar to that as heretofore described in connection with the first form set forth in that four speeds of drive of the drum shaft 1^a are had from the drive shaft 2^a through the use of three complementary pairs of drive and driven elements, the construction and location of which elements differ from that as heretofore described in connection with the first form of my invention.

In the form as illustrated in Figure 9, a sleeve 86^a is journaled upon the shaft 2^a. A sprocket 9^a, corresponding to the sprocket 9, is secured to one end of the sleeve, and a sprocket 11^a, similar to the sprocket 11, is secured to the opposite end of the sleeve. A sprocket 13^a is journaled on the shaft 2^a. The drive sprocket 88^a is secured directly to shaft 2^a at one end thereof. An auxiliary sprocket 87^a is likewise secured to the sleeve 86^a and may be used as a "rat-hole" sprocket or may be used to drive a cat shaft or other auxiliary units employed in the rotary process of drilling wells. Sprockets 8^a, 10^a and 12^a are journaled upon the drum shaft 1^a. The sprockets 10^a and 12^a are both formed upon the same sleeve so that they are dependently rotatable.

Clutches 17^a, 18^a, 19^a and 20^a are provided for releasably clutching transmission units to the respective shafts in order to provide for the transmission drives between the shafts. The high speed drive is accomplished by engaging the clutches 18^a and 20^a when the drive from the shaft 2^a to the shaft 1^a is from the sprocket 11^a to the sprocket 10^a. The second highest speed of drive is accomplished by engaging the clutch 19^a and the clutch 20^a. The drive established is then through sprocket 13^a to sprocket 12^a and shaft 1^a. The next lowest speed is established by engaging the clutch 18^a and the clutch 17^a. The drive is then through the sprocket 9^a to the sprocket 8^a direct to the drum 5^a. The lowest speed, or the fourth speed provided through the novel transmission arrangement embodied in my invention is provided when the clutches 19^a and the clutches 17^a are engaged. When thus engaged the drive is through the sprocket 13^a to the sprocket 12^a back through the sprocket 10^a to the sprocket 11^a and then through the sprocket 9^a to the sprocket 8^a and directly to the drum 5^a.

The rotary drive sprocket 29^a is journaled on the shaft 2^a and is adapted to be releasably clutched to the shaft 2^a through the clutch face 30^a of the double clutch 19^a. The double sprocket 31^a is journaled upon the drum shaft 1^a.

In order to provide for a two-speed drive of the rotary machine through the transmission connections provided, clutch teeth 88^a are formed at the end of the sleeve supporting the sprockets 10^a and 12^a and a clutch collar 89^a is splined upon a sleeve extension 90^a of the double sprocket 31^a. The two-speed drive for the rotary machine is provided by the following connections:

The highest speed by throwing the double clutch 19^a to the position where the clutch face 30^a engages the clutch face of the sprocket 29^a. The drive then from the sprocket 29^a to the smaller sprocket of the double sprocket 31^a and through the double sprocket to the rotary machine (not shown).

The second, or lower, speed drive to the rotary machine is provided by throwing the clutch 19^a to the position where sprocket 13^a is clutched to the shaft 2^a and by engaging the clutch 89^a with the clutch face 88^a so that the drive of the sprocket 12^a and the sprocket 13^a is transmitted to the double sprocket 31^a and hence to the rotary machine.

A third feature of the modified form of my invention resides in the invention of the clutch 17^a by means of which sprocket 8^a is clutched directly to the drum 5^a.

In this construction it would be inadvisable to weaken the shaft 1^a by forming a keyway therein at the point where the sprocket 8^a is mounted as this is the point of greatest stress upon the shaft 1^a. In order to overcome the necessity of forming such a keyway, the clutch is preferably of the form illustrated in Figures 9 and 12.

A clutch ring 91^a is splined on an internal spline within the sleeve extension 92^a of the sprocket 8^a and is provided with an end clutch face 93^a to engage the complementary clutch jaw 94^a formed on the end flange of the drum 5^a. A shifting collar 95^a is journaled on the shaft 1^a and is connected to the clutch jaw 91^a by means of studs 96^a. Any suitable or desirable form of clutch shifter means are provided in conjunction with each of the clutches as herein set forth in this modified form and may be similar to that set forth in connection with the clutch actuating means provided in the first form of my invention above described.

A further modified form of my invention is illustrated in Figures 10 and 11. This modified form of my invention differs from the first form described principally in the particular details as will hereinafter be pointed out, and similar parts in this modification are numbered with the same numbers with the addition of an exponent "b" thereto.

In the diagrammatic illustration of Figure 10, the rotary machine which is driven from the double rotary drive sprocket 31^b is illustrated at 97^b. In this construction a rotatably mounted drive sleeve 98^b is journaled upon a sleeve extension of the sprocket 13^b and a clutch 99^b is provided for releasably clutching the sprocket 99^b to the sprocket 13^b. The drive sprocket 80^b is moved to the outward end of the shaft 2^b and the clutch 22^b provides the means for releasably clutching this sprocket to the drive shaft 2^b. Drive sprocket 80^b is formed as a double sprocket with the direct drive sprocket 15^b.

With this rearrangement of the construction there is incorporated in the drawworks a feeding control which employs a variable speed hydraulic transmission for accurately governing the rate of feed of the drill pipe in the hole during the drilling operations. The feed control also includes one or more speed reduction units 100^b which are driven by suitable transmission connections from sprocket 98^b. The speed reduction unit 100^b is connected to a worm gear reduction unit 101^b. The worm gear reduction unit 101^b is connected through its common shaft 102^b with the motor end 103^b of the Waterbury gear drive. A fluid pump 104^b of the Waterbury gear drive is con-

nected by transmission 105^b with the sprocket 106^b journaled on the shaft 2^b.

A clutch 107^b is provided for releasably clutching the sprocket 106^b of the shaft 2^b. The motor unit 103^b of the Waterbury gear is connected through suitable conduits 108^b with the pump unit 104^b.

As is customarily provided in such hydraulic gear drives of the Waterbury pump type, a control screw 109^b is provided upon the pump end to vary the rate of discharge of oil to the motor end. The motor end is essentially a constant stroke motor and its speed is accurately governed by the rate of flow of oil delivered to it. Therefore, the setting of the control screw 109^b governs the speed of the shaft 102^b assuming that the shaft 2^b rotates at a constant speed.

With the clutches 107^b and 99^b engaged as the rotary drill pipe is lowered into the hole through the reeling out of the cable upon the drum 5^b, the speed of drop of the drill pipe is controlled. Assuming that the shaft 2^b is rotated at a constant speed through the drive sprocket 80^b and driving the rotary machine 97^b through the sprockets 29^b and the double sprocket 31^b by means of engagement of the clutch 30^b and that the clutches 107^b, 99^b and 17^b are engaged, the drum 5^b is driven at a very slow rate of drive through the various reductions thus included between the drive shaft 2^b and the drum shaft 1^b.

The speed at which the line is thus played out from the drum 5^b is controlled by the setting of the control screw 109^b as above described. Therefore the speed at which the drill pipe is lowered into the hole is accurately controlled.

During this operation it is possible to use the reduction available in the drawworks itself because the sprockets 9^b, 11^b and 13^b and the clutch 99^b float on the drive shaft 2^b and are not affected by its rotation which is necessary to drive the rotary machine 97^b. It will be obvious that the drilling control thus provided can be easily disconnected at will from the drilling apparatus simply by disengaging the clutches 107^b and 99^b and when thus disconnected the drawworks can be operated in the conventional manner.

The feed control thus described may be utilized as a transmission connection through which the drum of the drawworks may be rotated in a direction to raise or lower the tool suspended from the line wound upon the drum, or may be utilized to hold the same in position.

With the modified form of drawworks, including the hydraulic feed control, when desired the full power of the transmission drive to the drawworks drum and the rotary machine may be had without driving through the feed control.

In the construction of drawworks illustrated in Figure 3, the end frames are formed in sections with the upper section bolted to the lower section, permitting removal of the upper section without disturbing the drive shaft 2 or the cat shaft 3, or the clutch operating mechanism. Thus it is possible, by removing these frame sections and supporting the drum upon blocks, or in any other manner, to remove and replace the brake rim 6 assembly without dismantling the drum shaft 1 or removing the drum shaft from the drawworks.

In this form of drawworks it is also apparent that a high speed direct drive is provided with only one moving transmission chain through the high speed drive obtained from sprocket 15 through chain 16 to sprocket 14.

Having fully described my invention, it is to

be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a rotary drawworks, the combination of a drive shaft, a driven shaft, means for driving the drive shaft, a rotary drive sprocket mounted on the drive shaft, a double rotary drive sprocket on the driven shaft, means for releasably engaging the rotary drive sprocket with the drive shaft, a transmission connection from the rotary drive sprocket to one sprocket of the double sprocket, a transmission element on the driven shaft, means for directly coupling the transmission element to the double sprocket, and a releasable transmission drive from the drive shaft to said transmission element to drive the double rotary sprocket at a second speed.

2. In a rotary drawworks, the combination of a drive shaft, a drum shaft, a drum mounted thereon, a single sprocket rotatably mounted on each shaft, a double sprocket rotatably mounted on each shaft and positioned immediately adjacent the single sprocket, one sprocket of each double sprocket being mutually aligned, the other sprocket of each double sprocket being aligned with one of said single sprockets, transmission connections between each pair of aligned sprockets, a pair of spaced clutches splined on each shaft with a single sprocket and a double sprocket interposed between them, separate actuating means to selectively engage each respective clutch, one of said means including an element slidably mounted on the drum shaft, said drum being interposed between said element and its respective clutch.

3. In a rotary drawworks, the combination of a drive shaft having a rotary machine drive sprocket mounted thereon, means to drive the drive shaft, a drum shaft parallel to the drive shaft and having a spooling drum mounted thereon, a pair of sprocket members rotatably mounted on the drum shaft with said drum interposed between them, a sleeve rotatably mounted on the drive shaft and extending laterally beyond both ends of said drum, a pair of sprockets fixed upon said sleeve in spaced relation and each aligned with one of said drum shaft sprocket members, transmission connections between each pair of aligned sprockets, selective clutch means whereby either of said drum shaft sprocket members may drive said drum, additional clutch means adapted to selectively engage said sleeve with said drive shaft, said drive shaft being adapted to drive the rotary machine drive sprocket independently of the drum, upon disengagement of the last mentioned clutch means.

4. In a rotary drawworks, the combination of a drive shaft having a rotary machine drive sprocket mounted thereon, means to drive the drive shaft, a drum shaft parallel to the drive shaft and having a spooling drum mounted thereon, a pair of sprocket members rotatably mounted on the drum shaft with said drum interposed between them, a sleeve rotatably mounted on the drive shaft and extending laterally beyond both ends of said drum, a pair of sprockets fixed upon said sleeve in spaced relation and each aligned with one of said drum shaft sprocket members, transmission connections between each pair of aligned sprockets, selective clutch means whereby either of said drum shaft sprocket members may drive said drum, drive means whereby the drive shaft may drive the sleeve at a plurality of speeds, said drive shaft

being adapted to drive the rotary machine drive sprocket independently of the drum, upon said drive means being rendered inoperative.

5 In a rotary drawworks, the combination of a drive shaft having a rotary machine drive sprocket mounted thereon, means to drive the drive shaft, a drum shaft parallel to the drive shaft and having a spooling drum mounted thereon, a single sprocket member and a double
10 sprocket member rotatably mounted on the drum shaft with the drum interposed between them, a sleeve rotatably mounted on the drive shaft and extending laterally beyond both ends of said drum, a pair of sprockets fixed upon said sleeve
15 in spaced relation, one being aligned with the single sprocket member and the other being

aligned with one of the sprockets on the double sprocket member, a supplementary drive sprocket rotatably mounted on the drive shaft and aligned with the other of the sprockets on the double sprocket member, transmission connections between each pair of aligned sprockets, selective clutch means whereby either of said drum shaft sprocket members may drive said drum, additional clutch means whereby the drive shaft may selectively drive either the sleeve or the supplementary drive sprocket, said drive shaft being
10 adapted to drive the rotary machine drive sprocket independently of the drum, upon disengagement of the last mentioned clutch means.

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