

Dec. 2, 1930.

W. D. DAVIDSON

1,783,914

DRAW WORKS FOR USE WITH HILD DRIVES

Filed June 12, 1929

3 Sheets-Sheet 1

Fig. 2.

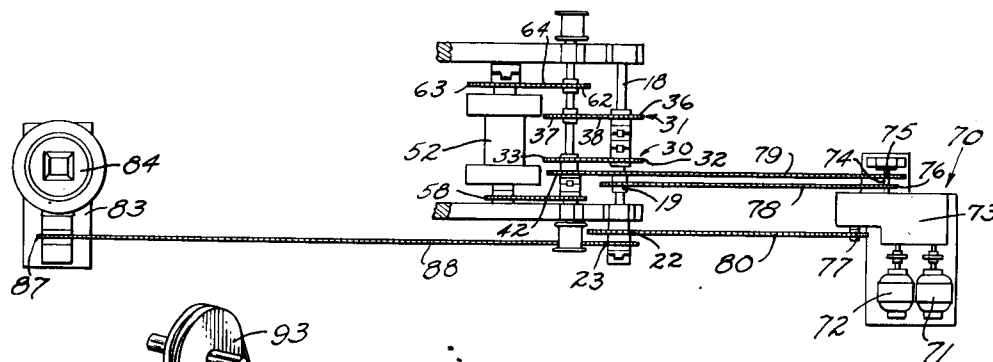
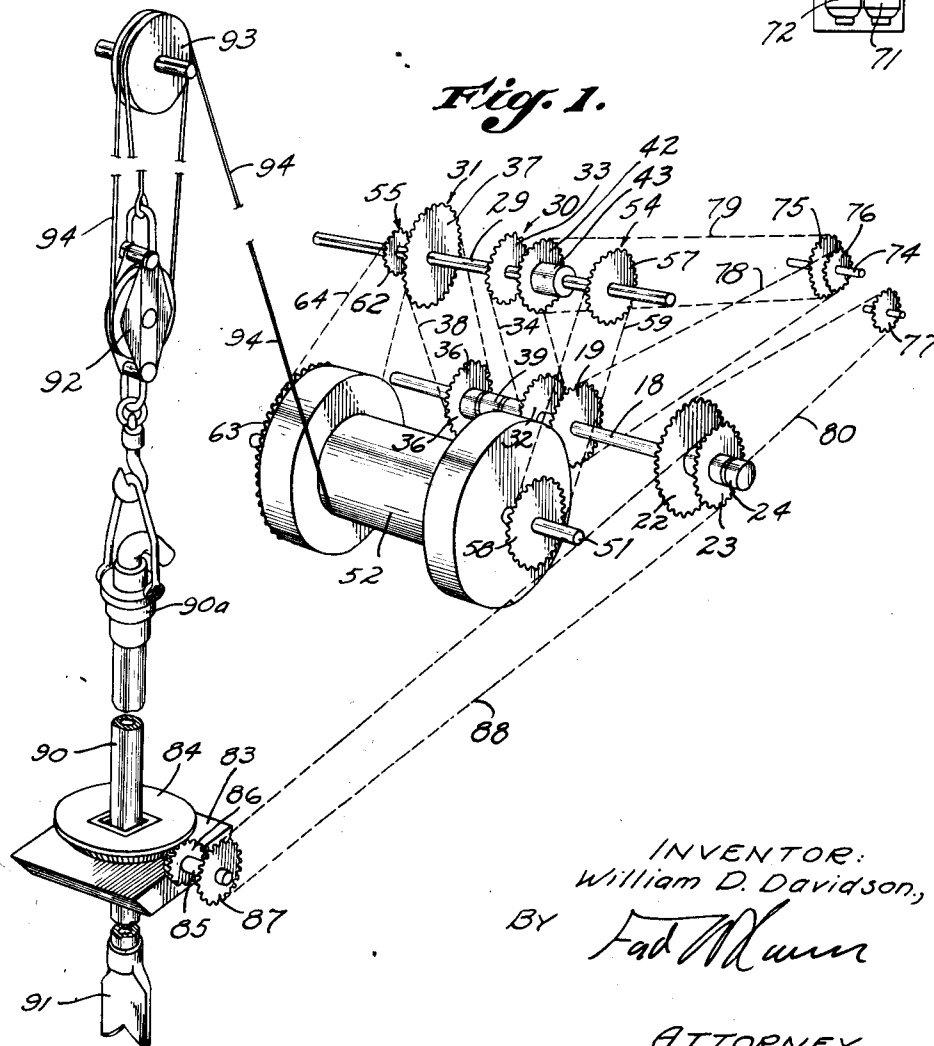


Fig. 1.



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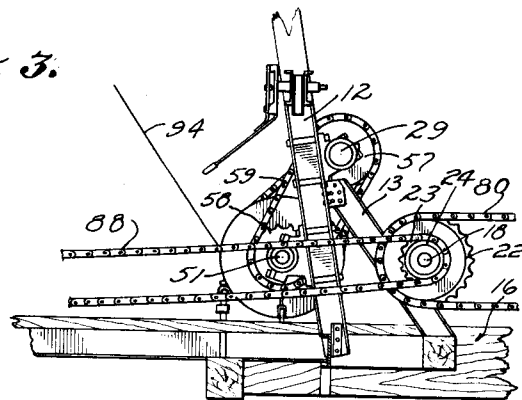
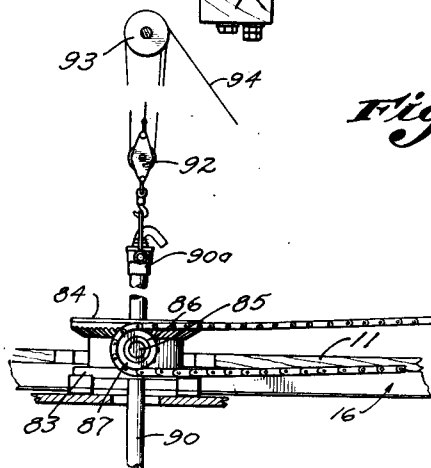
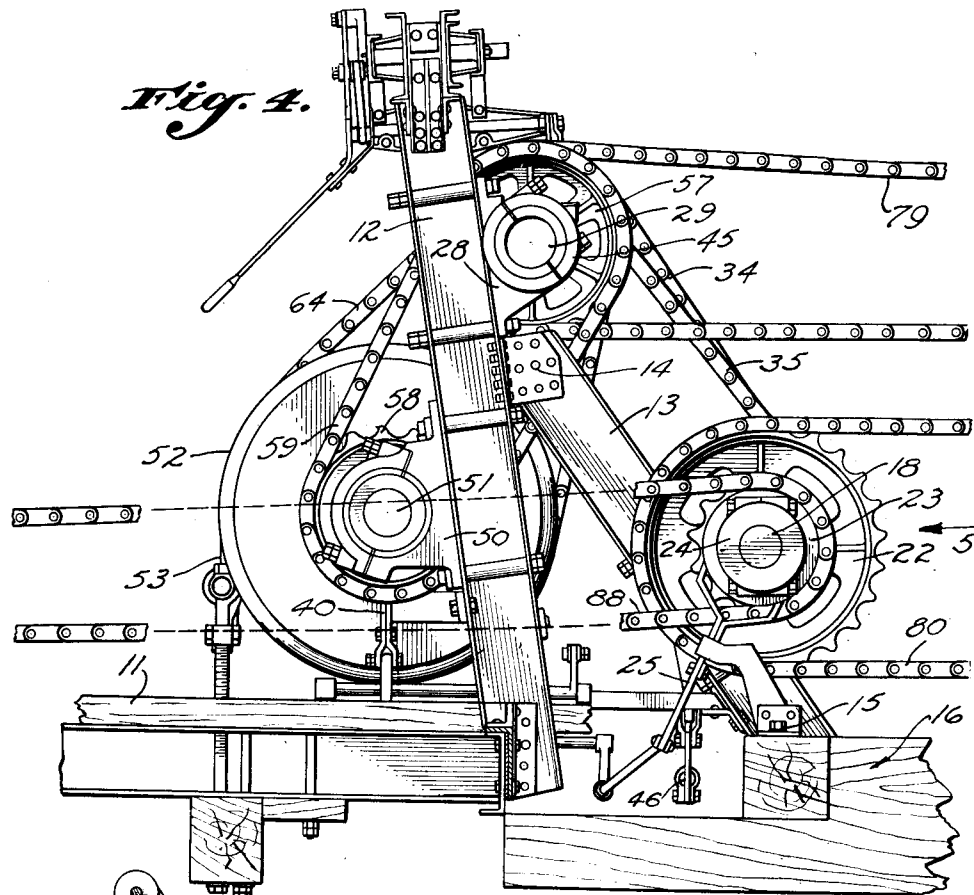
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DRAW WORKS FOR USE WITH HILD DRIVES

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3 Sheets-Sheet 2



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DRAW WORKS FOR USE WITH HILD DRIVES

Filed June 12, 1929

3 Sheets-Sheet 3

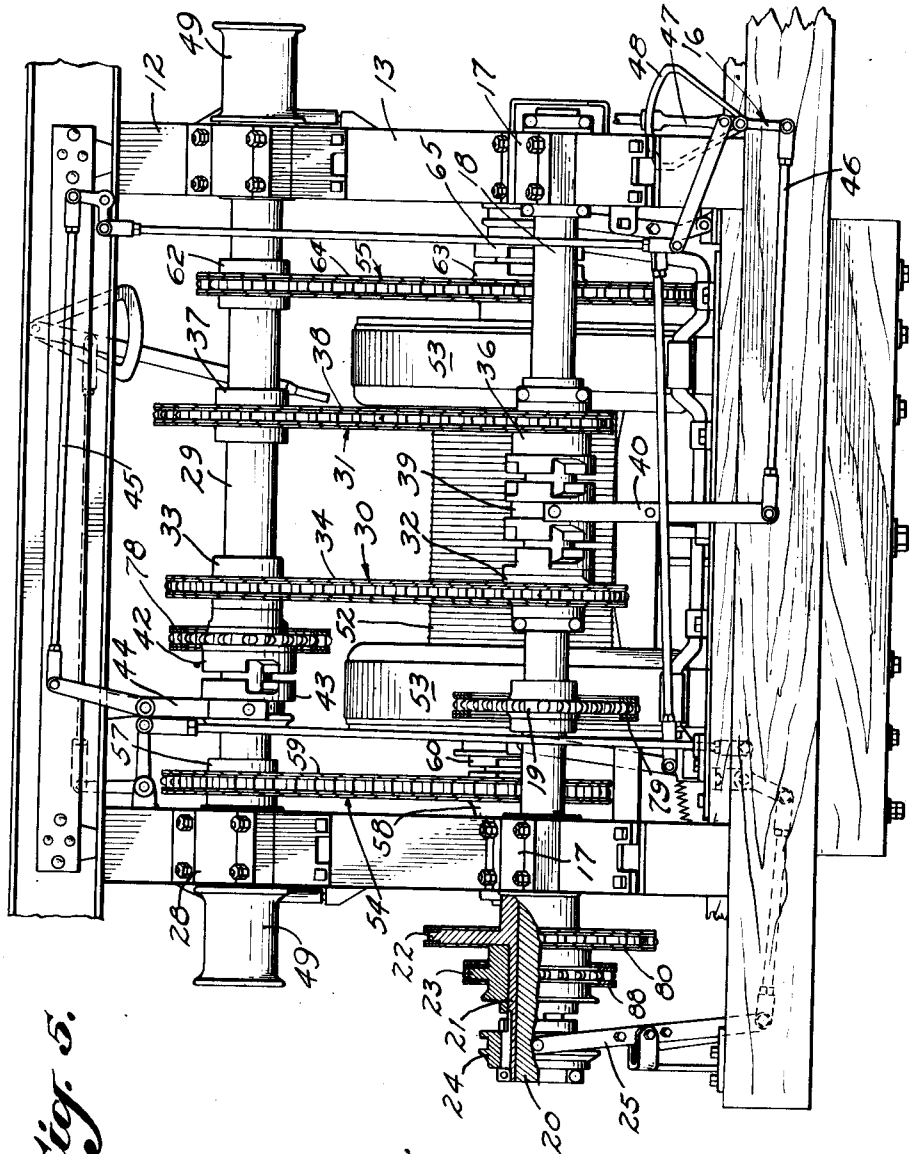


Fig. 5.

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UNITED STATES PATENT OFFICE

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DRAW WORKS FOR USE WITH HILD DRIVES

Application filed June 12, 1929. Serial No. 370,405.

My invention relates to draw-works such as are employed in the oil-drilling industry and it relates particularly to a draw-works adapted for use in connection with a differential drive device.

The differential drive device, such as the Hild differential drive now extensively used in the oil-producing industry, consists of a driving mechanism including differential means, a portion of which is adapted to operate the rotary machine for rotating the drill pipe and another portion of which is adapted to operate the spooling drum of the draw-works for feeding the drill pipe downward as the bit drills the hole. The differential drive device is so designed that as the drilling operations progress the bit will be fed downward. If a hard material is encountered feeding will be slower and if soft material is being penetrated the feeding will be faster.

It is one of the objects of this invention to provide a draw-works adapted for use in connection with a differential drive device.

A further object of the invention is to provide a draw-works of this character in which the spooling drum will have a number of speeds.

It is a further object of the invention to provide a combination in which the differential drive has primary and secondary means for driving that portion of the draw-works which operates the spooling drum. Either the primary or the secondary driving means may be utilized, according to the speed desired.

A still further object of my invention is to provide a combination of the character mentioned in which the chain which drives the rotary machine is extended along the floor of the derrick so that it will not impede drilling operations.

Other objects and advantages of the invention reside in the details of construction of the preferred form of my invention and

they will be pointed out in the following description.

Referring to the drawings in which my invention is illustrated:

Fig. 1 is a diagrammatic view showing the arrangement of the various operating parts of my invention.

Fig. 2 is a plan view of the apparatus.

Fig. 3 is an elevational view of a portion of the apparatus.

Fig. 4 is an elevational side view of the draw-works itself.

Fig. 5 is an elevational view of the draw-works taken as indicated by the arrow 5 of Fig. 4.

Referring to the drawings in detail and particularly to Figs. 2, 4 and 5, the numeral 11 represents the floor of a derrick at the side of which are uprights or posts 12. Bracing the posts 12 are diagonal brace members 13. The upper ends of the brace members 13 are secured at 14 to the uprights and the lower ends are secured at 15 to beams 16, which extend along the ground level. Mounted on the brace members 13 are bearings 17, which rotatably support a counter-shaft 18. Rigidly secured to the counter-shaft 18 is a primary driven sprocket 19. Rotatably mounted on an end 20 of the counter-shaft, which extends outwardly from one of the uprights 12, is a sleeve 21 having a tertiary driven sprocket 22 formed integrally therewith or rigidly secured thereon. Rotatable on the sleeve 21 is a rotary machine drive sprocket 23. Also mounted on the sleeve 21 is a clutch element 24 which may be moved by a lever 25 so as to engage the rotary machine drive sprocket 23 and drivably connect it to the sleeve and to the tertiary driven sprocket 22.

Bearings 28 are secured to the uprights 12 near the upper ends thereof and rotatably supported by these bearings 28 is a line shaft 29, the line shaft 29 being disposed above the counter-shaft 18 in a plane parallel there-

to. The line shaft 29 may be driven from the counter-shaft 18 by high speed means 30 and low speed means 31. The high speed means 30 consists of a sprocket 32 rotatable on the counter-shaft 18, a driven sprocket 33 rigidly secured on the line shaft 29, and a chain 34 which extends over these sprockets.

The low speed drive means 31 consists of a drive sprocket 36 rotatable on the counter-shaft 18, a driven sprocket 37 rigidly secured on the line shaft 29, and a chain 38 extending over these sprockets. Either the drive sprocket 32 or the drive sprocket 36 is drivably connected to the counter-shaft 18 by a slidable clutch element 39, which may be moved by means of a lever 40. It will be seen that by this arrangement it is impossible for both of the drive sprockets 32 and 36 to be engaged simultaneously.

Rotatable on the line shaft 29 adjacent to the high speed driven sprocket 33 is a secondary driven sprocket 42. The secondary driven sprocket 42 may be drivably connected to the line shaft 29 by means of a clutch element 43, which may be moved into and out of driving engagement by means of a shift lever 44. The shift lever 44 and lever 40 are connected by suitable operating rods 45 and 46 to a common manual operating lever 47 which has a slotted guide 48. The slotted guide 48 has slots which permit the operating lever 40 to move either the clutch element 39 or the clutch element 43 into engagement, but prohibits both of the clutch elements from being engaged at the same time.

Secured to the line shaft on the opposite ends thereof are catheads 49 which are used for breaking joints of pipe installed in the well.

Secured to the uprights 12 on the inner faces thereof and near the lower ends thereof are bearings 50 which rotatably support a drum shaft 51. The drum shaft 51 carries a spooling drum 52 including brakes 53 operable by suitable brake actuating mechanism.

The drum shaft 51 may be driven from the line shaft 29 by high speed drive means 54 and low speed drive means 55. The high speed drive means 54 consists of a sprocket 57 rigidly secured on the line shaft 29, a sprocket 58 rotatable on the drum shaft 51 and a chain 59 extending around the sprockets 57 and 58. A clutch element 60 is slidable on the drum shaft 51 for engaging the sprocket 58 in order to provide driving connection between the sprocket 58 and the drum shaft 51. The low speed drive means consists of a drive sprocket 62 rigidly mounted on the line shaft 29, a driven sprocket 63 rotatable on the drum shaft 51, and a chain 64 extending around these sprockets. A clutch element 65 is slidable on the drum shaft 51 and may be moved into engagement with the sprocket 63 for providing driving

engagement between this sprocket and the drum shaft 51.

I have described the essential elements of the draw-works which forms the essence of my invention and also forms a part of a combination which is also included in my invention.

I have not gone into the details of construction of the various parts of the draw-works in view of the fact that in the details not specifically pointed out standard construction is adhered to. For example, the construction of the drum 52 and the brakes 53, and the construction of the clutches and the mechanism for operating the clutches are made according to standard design and are well known by those versed in the art.

In Fig. 2 a differential drive device is indicated at 70. This differential drive device may be of any construction and employs motors 71 and 72, which are connected to a differential gear box 73. Extending from the differential gear box 73 is a shaft 74 having a primary drive sprocket 75 and a secondary drive sprocket 76 mounted thereon. Also extending from the gear box 73 is a tertiary drive sprocket 77. Extending around the secondary drive sprocket 76 and the primary driven sprocket 19, mounted on the counter-shaft 18, is a chain 78 by means of which the counter-shaft is driven at all times when the differential drive device 70 is in operation. Extending around the primary drive sprocket 75 and the secondary driven sprocket 42, rotatably mounted on the line shaft 29, is a chain 79. The chains 78 and 79 operate whenever the differential drive 70 is in operation. The secondary driven sprocket 42 always rotates but does not drive the line shaft 29 unless the clutch element 43 is in engaging position.

Extending around the tertiary drive sprocket 77 and around the tertiary driven sprocket 22 is a chain 80, which chain 80 rotates whenever the differential drive is in operation. The tertiary drive sprocket 22 and the sleeve 21 rotate therewith.

Supported at the central part of the floor of the derrick is a rotary machine 83 including a rotary table 84, a shaft 85, a pinion 86 and a sprocket 87. Extending around the sprocket 87 and the rotary machine drive sprocket 23 is a chain 88 by means of which the rotary table 84 is rotated when the clutch element 24 is engaging the rotary machine drive sprocket 23.

Extending through the rotary table 84 is a drill pipe 90, which is driven thereby, the drill pipe 90 having a bit 91 secured on the lower end thereof. Attached to the upper end of the drill pipe 90 is a swivel head 90^a and supporting the drill pipe is a traveling block 92. Extending around the traveling block 92 and sheaves of a crown block 93 is

a cable 94, the end of the cable 94 being wound on the drum 52.

Having described the construction of my invention, I will now describe the operation thereof.

Assuming that the drill pipe 90 has been installed in the well to such a position that the bit 91 is in drilling position the differential drive 70 is placed in operation. The tertiary drive sprocket 77 through the inter-connecting parts operates the rotary machine. The drum 52 may be operated either from the primary drive sprocket 75 or the secondary drive sprocket 76, as desired. If the drum is to be operated from the primary drive sprocket 75, the clutch element 43 is disengaged so that the secondary driven sprocket 42 is disengaged from the line shaft 29.

Either the high speed drive means or the low speed drive means 30 or 31 is connected to drive the line shaft 29 from the counter-shaft 18. Also, either the high speed drive means 54 or the low speed drive means 55 is connected so that the drum shaft 51 will be driven from the line shaft 29.

If it is desired to drive the drum from the line shaft 29 and not through the counter-shaft 18 the clutch element 39 is moved into disengaged position so that neither of the drive means 30 or 31 will drive the line shaft 29, and the clutch element 43 will be thrown into a position to drivably connect the secondary driven sprocket 42 and the line shaft 29.

The tertiary drive sprocket 77 rotates the rotary table 84 so that the drill pipe 90 and bit 91 are rotated at a proper drilling rate of rotation. As the bit 91 cuts away the bottom of the hole the drill pipe 90 is fed downward by the drive mechanism of the drum, rotating the drum to cause this feeding action. If the drilling action of the bit 91 is uniform the drum will slowly rotate at a uniform rate of speed so that the feeding action will be uniform. When drilling through a hard formation the feeding will be slower than when drilling through a soft formation. This feeding is accomplished by the differential drive device 70, which operates to rotate the primary and secondary drive sprockets 75 and 76 at such a speed that the drill pipe will be fed downward so that a certain drilling pressure will be maintained on the bit 91. It will be seen that by the operation of the device the drilling is automatic, and drilling conditions are maintained substantially constant by the differential drive device.

In my invention I utilize the features of the differential drive device and utilize certain important features of a preferred form of draw-works. The draw-works makes it possible to operate the drum at different gear ratios in order to adjust its sensitiveness. The use of a dual drive from the differential

drive device, one of which drives is connected to the line shaft and the other of which drives is connected to the counter-shaft, comprises an important part of the invention. The arrangement of the sprockets 22 and 23 and the clutch 24 also embodies an important part of the invention, since it makes it possible to minimize operating parts by utilizing the end of the counter-shaft 18 as an orbit. A further feature of the invention resides in the fact that the rotary machine drive means is low so that the chain 88 may be extended along the floor of the derrick and not be in the way.

It should be understood that I am not limited to the particular differential drive means shown as I may use any drive means such as a triple sprocket on a steam engine for driving my draw-works.

I claim as my invention:

1. In a draw-works of the class described, the combination of: a counter-shaft; a drive means for driving said counter-shaft; a line shaft; means whereby said counter-shaft may drive said line shaft; a drum shaft; means whereby said line shaft may drive said drum shaft; and means on said line shaft whereby said drive means may drive said line shaft.

2. In a draw-works of the class described, the combination of: a counter-shaft; a primary driven sprocket secured on said counter-shaft, said primary driven sprocket being driven by a drive means; a line shaft; means whereby said counter-shaft may drive said line shaft; a drum shaft; means whereby said line shaft may drive said drum shaft; a secondary driven sprocket rotatable on said line shaft, said secondary driven sprocket being driven by said drive means; and a clutch for drivably connecting said secondary driven sprocket to said line shaft.

3. In a draw-works of the class described, the combination of: a counter-shaft; a primary driven sprocket secured on said counter-shaft, said primary driven sprocket being driven by a drive means; a line shaft; a power drive means whereby said counter-shaft may drive said line shaft; a drum shaft; means whereby said line shaft may drive said drum shaft; a secondary driven sprocket rotatable on said line shaft, said secondary driven sprocket being driven by said drive means; a clutch for drivably connecting said secondary driven sprocket to said line shaft; and interlocking means for said clutch and said power drive means whereby said line shaft may be individually driven from said counter-shaft or said drive means.

4. In a draw-works of the class described, the combination of: a spooling drum; a line shaft; a counter-shaft; means whereby said line shaft may drive said drum; transmission means for driving said line shaft directly from a draw-works drive means at a definite speed relative to the speed of said drive means; other transmission means for indi-

rectly driving said line shaft from said drive means through said counter-shaft at different definite speeds relative to the speed of said drive means; and control means for adjusting said transmission means for either a direct or an indirect drive of said line shaft to vary the driving ratio between said drive means and said line shaft.

5. In a draw-works of the class described, the combination of: a spooling drum; a line shaft; a counter-shaft; means whereby said line shaft may drive said drum; a primary driven means for directly driving said counter-shaft from a draw-works drive means; a secondary driven means for directly driving said line shaft from said draw-works drive means; speed-change means between said counter-shaft and said line shaft; and control means adjustable to cause said line shaft to be driven directly through said secondary driven means or indirectly through said primary driven means, said counter-shaft and said speed-change means.

6. In a draw-works of the class described, the combination of: a spooling drum; a line shaft; a counter-shaft; means whereby said line shaft may drive said drum; a primary driven sprocket secured on said counter-shaft whereby said counter-shaft may be directly driven by a draw-works drive means; a secondary driven sprocket rotatable on said line shaft and adapted to be directly driven by said draw-works drive means; speed-change means between said counter-shaft and said line shaft; clutch means associated with said speed-change means; and clutch means adapted to drivably connect said secondary driven sprocket to said line shaft, said clutch means being alternately operable to cause said secondary driven sprocket to directly drive said line shaft or to cause said line shaft to be driven indirectly by said primary driven sprocket through said counter-shaft and speed-change means.

7. In an apparatus of the class described, the combination of: a rotary machine drive means; a draw-works drive means; a differential device connecting said drive means; a spooling drum; a line shaft; a counter-shaft; means whereby said line shaft may drive said drum; transmission means for driving said line shaft directly from said draw-works drive means at a definite speed relative to the speed of said rotary machine drive means; other transmission means for indirectly driving said line shaft from said draw-works drive means through said counter-shaft at different definite speeds relative to the speed of said rotary machine drive means; and control means for adjusting said transmission means for either a direct or an indirect drive of said line shaft to vary the driving ratio between the drum and the rotary machine drive means.

8. In an apparatus of the class described,

the combination of: a rotary machine drive means; a draw-works drive means; a differential device connecting said drive means; a spooling drum; a line shaft; a counter-shaft; means whereby said line shaft may drive said drum; a primary driven means for directly driving said counter-shaft from said draw-works drive means; a secondary driven means for directly driving said line shaft from said draw-works drive means; speed-change means between said counter-shaft and said line shaft; and control means adjustable to cause said line shaft to be driven directly through said secondary driven means or indirectly through said primary driven means, said counter-shaft and said speed-change means.

9. In an apparatus of the class described, the combination of: a rotary machine drive means; a draw-works drive means having a primary drive sprocket and a secondary drive sprocket; a differential device connecting said drive means; a spooling drum; a line shaft; a counter-shaft; means whereby said line shaft may drive said drum; a primary driven sprocket secured on said counter-shaft; means connecting said primary sprockets whereby said counter-shaft may be directly driven by said draw-works drive means; a secondary driven sprocket rotatable on said line shaft; means connecting said secondary sprockets whereby said secondary driven sprocket may be directly driven by said draw-works drive means; speed-change means between said counter-shaft and said line shaft; clutch means associated with said speed-change means; and clutch means adapted to drivably connect said secondary driven sprocket to said line shaft, said clutch means being alternately operable to cause said secondary driven sprocket to directly drive said line shaft or to cause said line shaft to be driven indirectly by said primary driven sprocket through said counter-shaft and speed-change means.

10. In an apparatus of the class described, the combination of: a drive means having primary and secondary drive sprockets for driving a draw-works, a tertiary drive sprocket for driving a rotary machine, and an intermediate differential mechanism; a counter-shaft; a primary driven sprocket secured to said counter-shaft and driven by said primary drive sprocket; a line shaft; speed-change means whereby said counter-shaft may drive said line shaft; a secondary driven sprocket rotatable on said line shaft and driven by said secondary drive sprocket; a spooling drum; means whereby said line shaft may drive said drum; a clutch for drivably connecting said secondary driven sprocket to said line shaft; clutch means associated with said speed-change means; and means whereby said tertiary drive sprocket may drive a rotary machine, said clutch and said clutch

means being selectively operable to cause a direct drive of said line shaft by said secondary driven sprocket or an indirect drive of said line shaft by said primary driven sprocket through said counter-shaft and said speed-change means, to vary the driving ratio between the line shaft which drives the spooling drum and the means which drives the rotary machine.

10 In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 31st day of May, 1929.

WILLIAM D. DAVIDSON.

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