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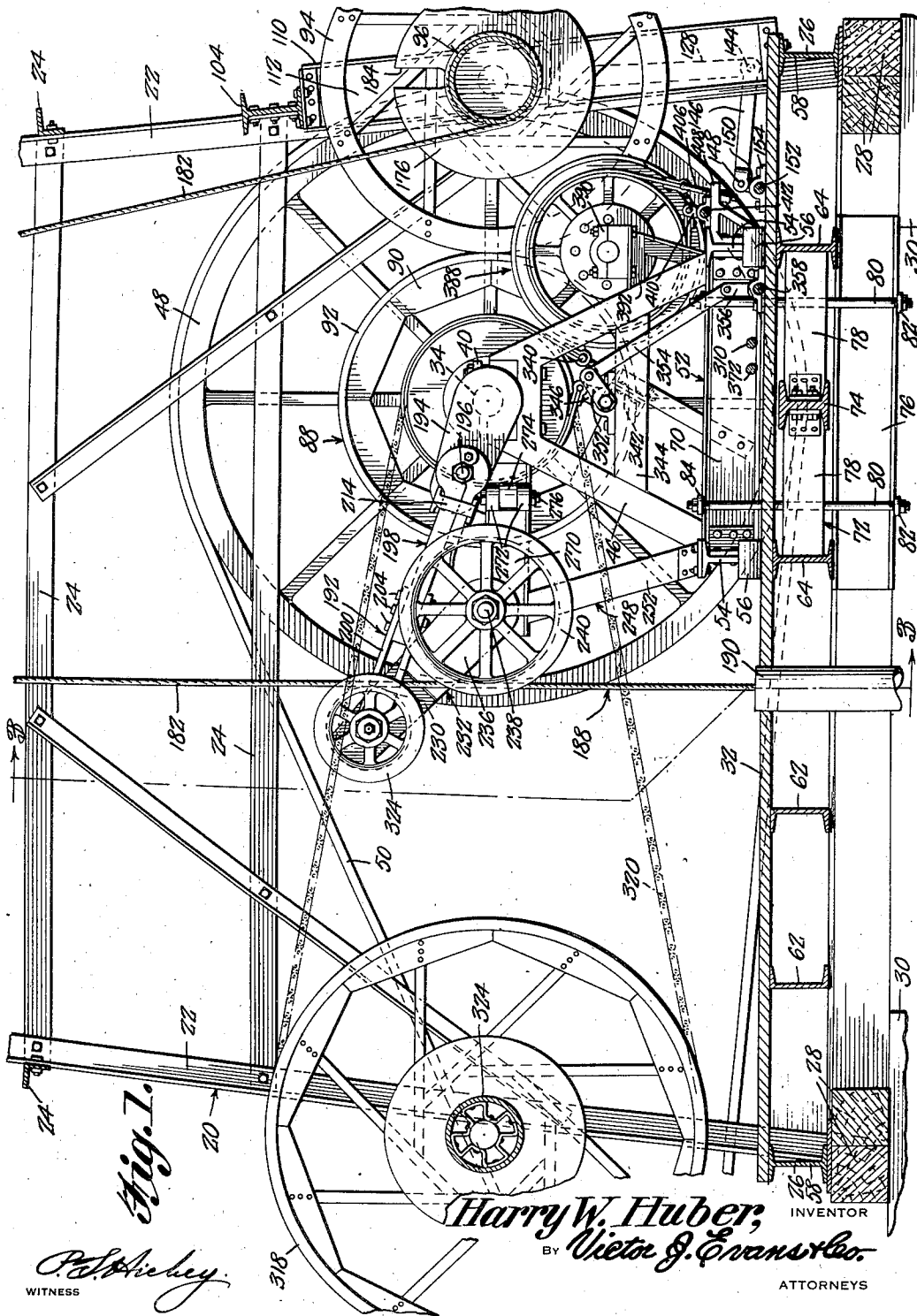
H. W. HUBER

2,190,235

DRILLING APPARATUS

Filed May 22, 1939

8 Sheets-Sheet 1



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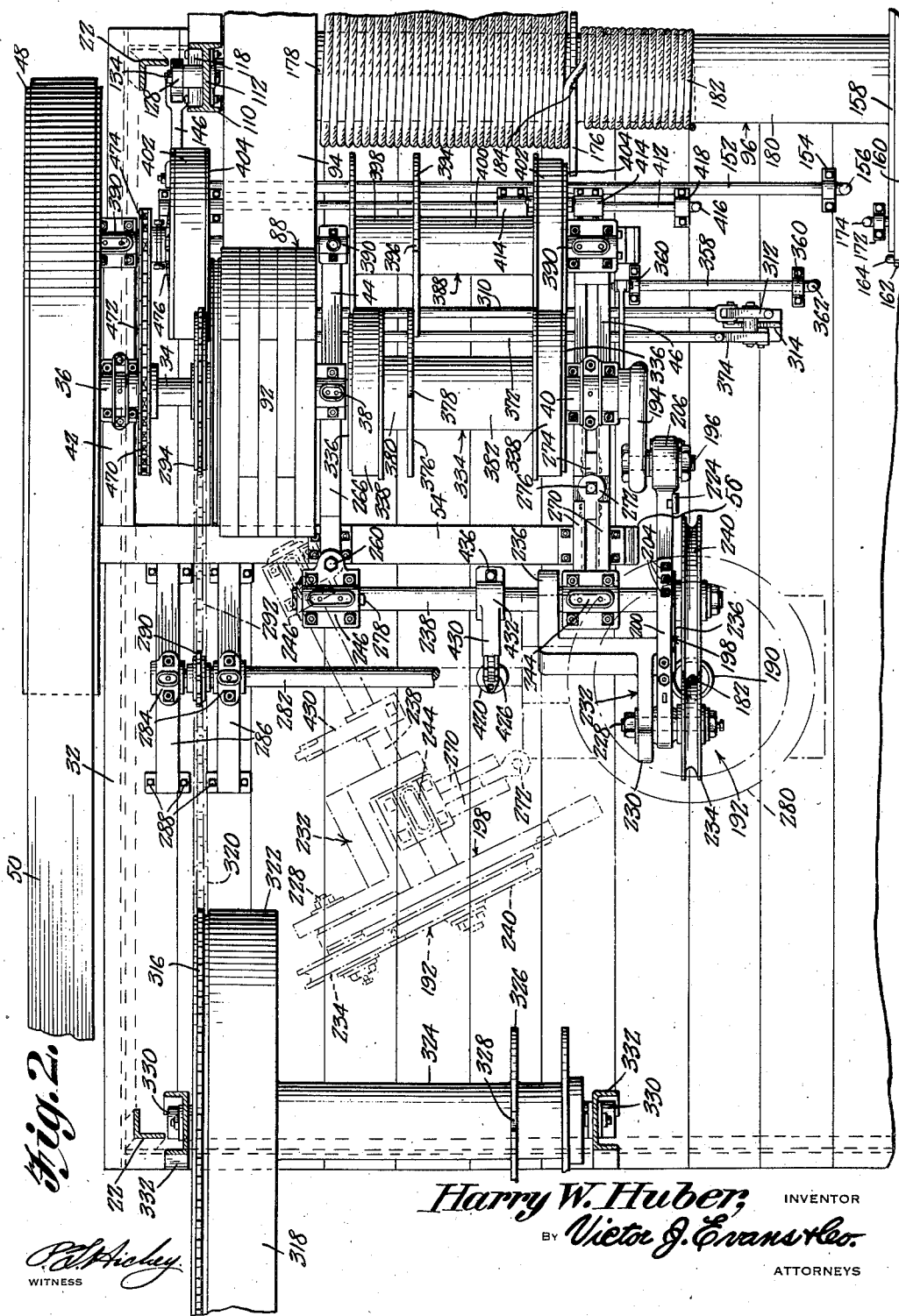
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DRILLING APPARATUS

Filed May 22, 1939

8 Sheets-Sheet 2



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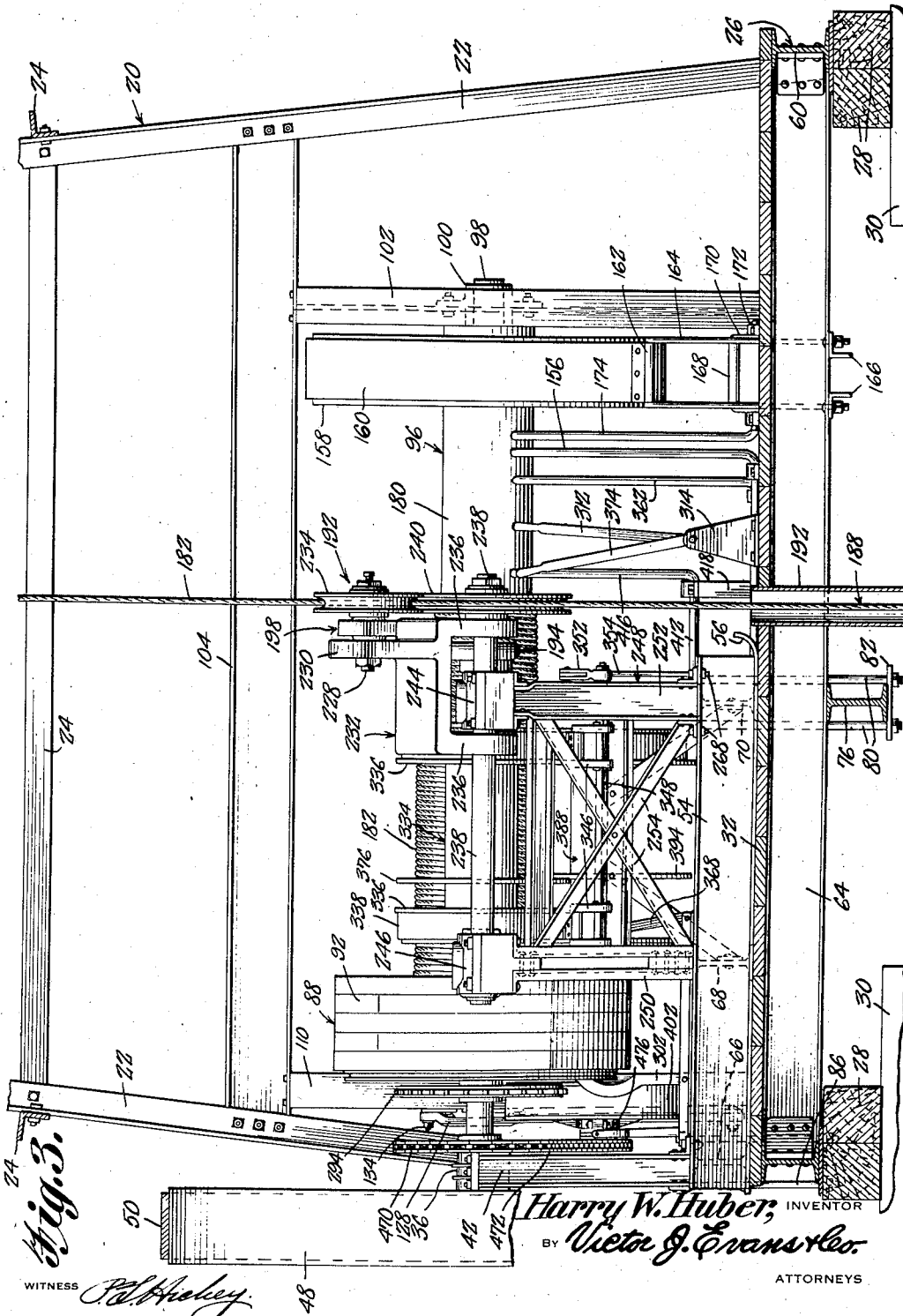
H. W. HUBER

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DRILLING APPARATUS

Filed May 22, 1939

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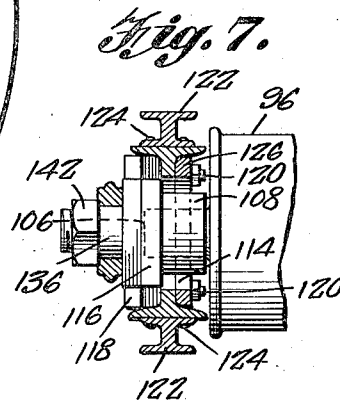
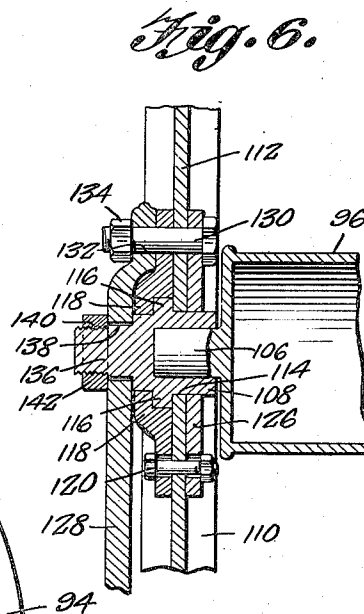
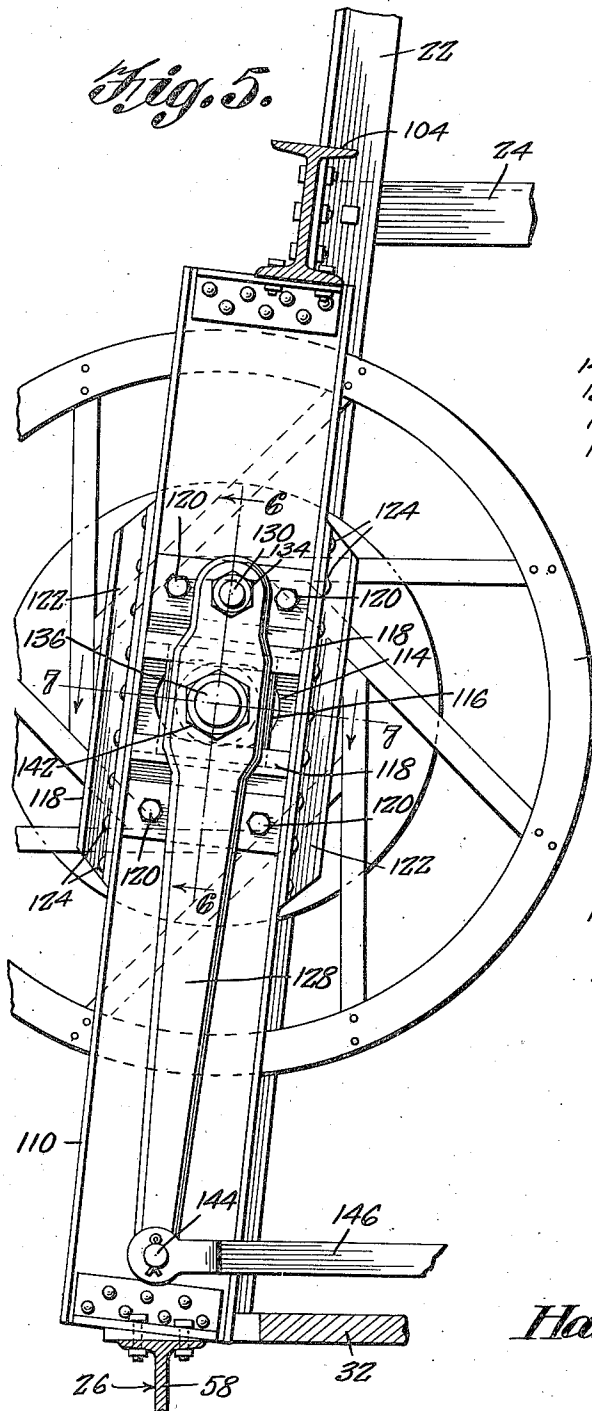
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2,190,235

DRILLING APPARATUS

Filed May 22, 1939

8 Sheets-Sheet 5



WITNESS

P. H. Hickey

Harry W. Huber,

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Feb. 13, 1940.

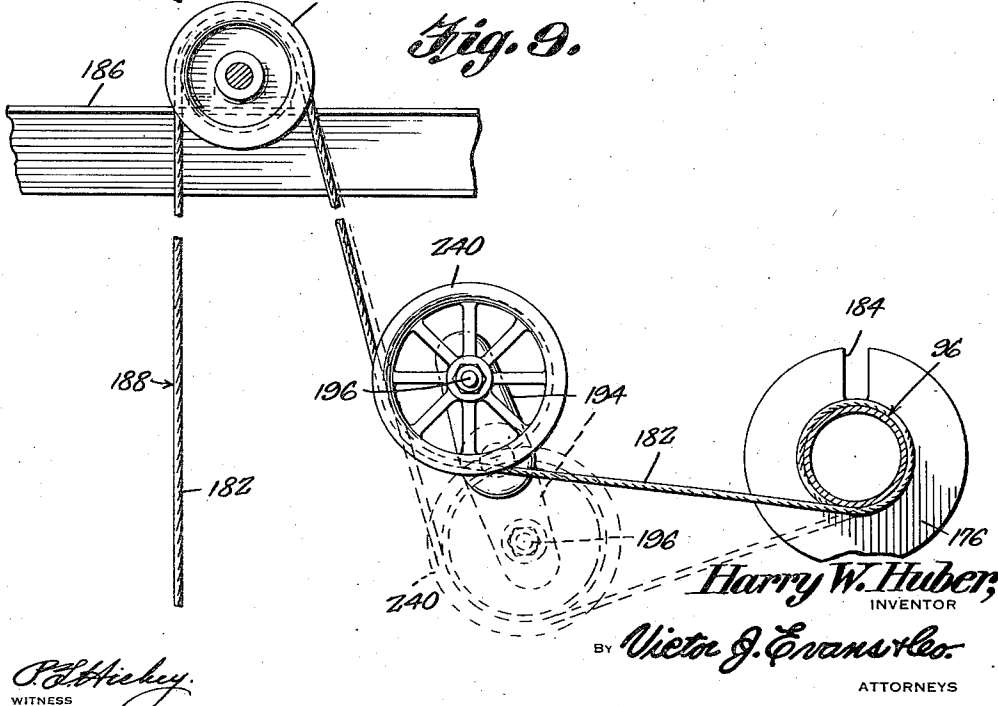
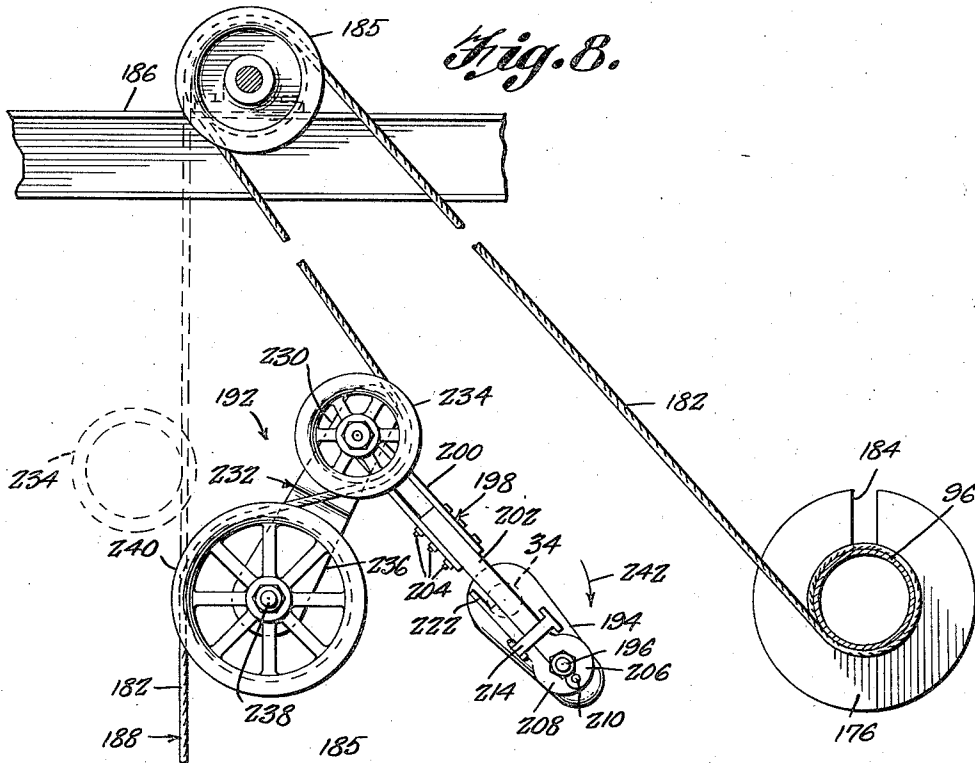
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2,190,235

DRILLING APPARATUS

Filed May 22, 1939

8 Sheets-Sheet 6



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DRILLING APPARATUS

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Fig. 13.

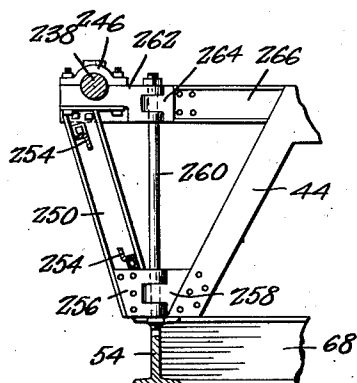


Fig. 14.

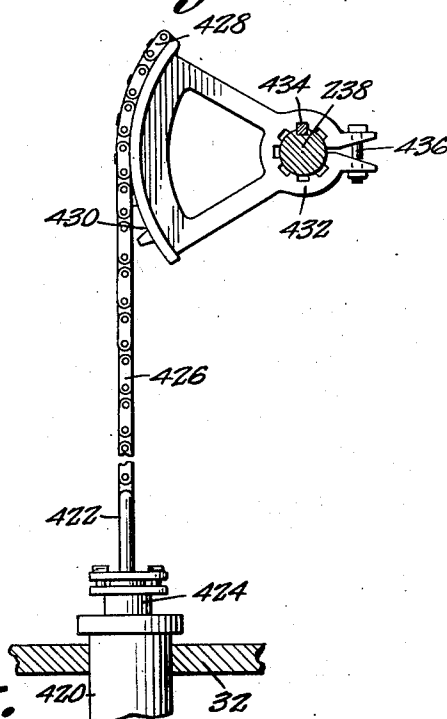
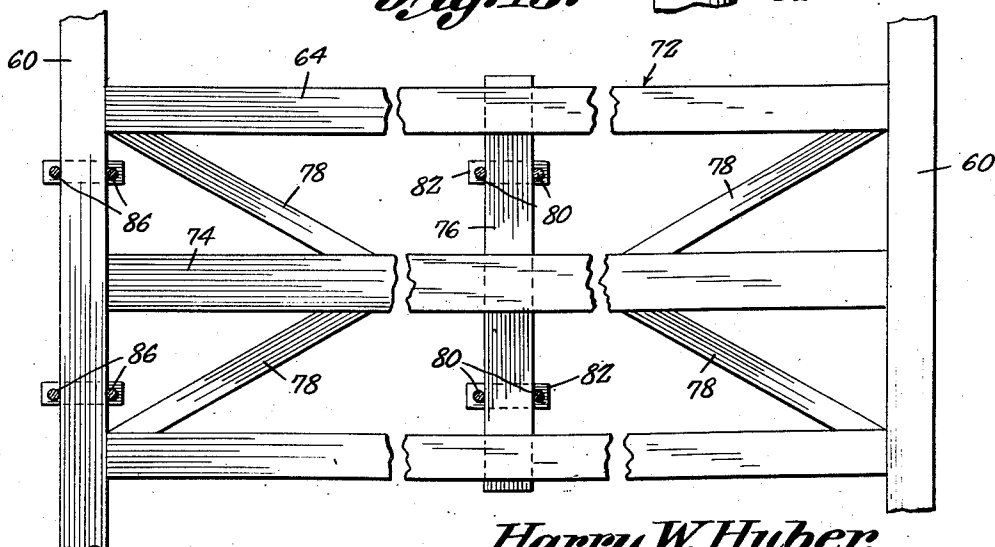


Fig. 15.



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DRILLING APPARATUS

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Fig. 16.

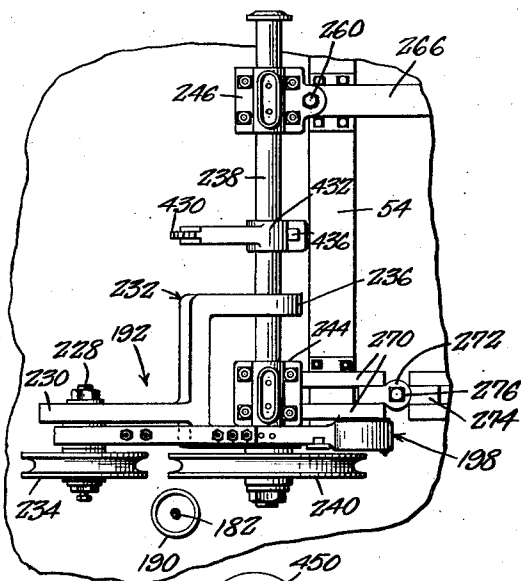
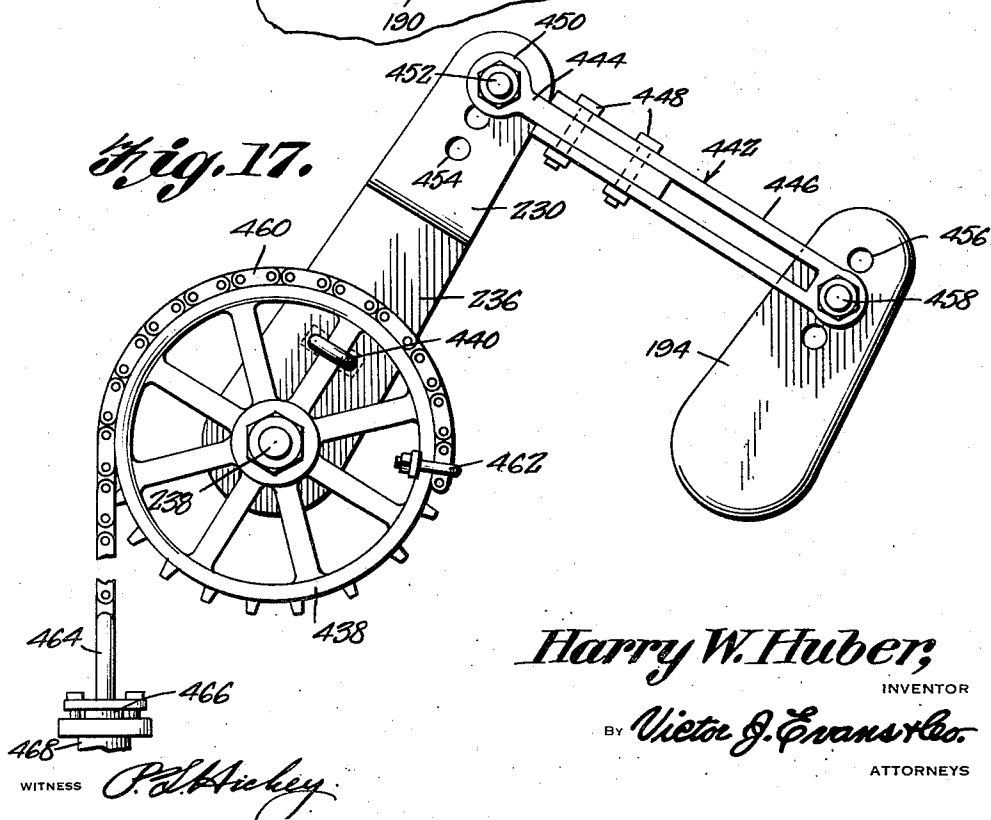


Fig. 17.



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UNITED STATES PATENT OFFICE

2,190,235

DRILLING APPARATUS

Harry W. Huber, Brookville, Pa.

Application May 22, 1939, Serial No. 275,041

19 Claims. (Cl. 255—2)

My invention relates to the art of drilling gas, oil wells and the like, and has among its objects and advantages the provision of an improved drilling apparatus.

In the accompanying drawings:

Figure 1 is a side elevational view of my invention with certain parts broken away for the sake of clearness;

Figure 2 is a top plan view of the structure shown in Figure 1;

Figure 3 is a view taken from the position indicated by line 3—3 of Figure 1;

Figure 4 is an elevational view of the main drive shaft and the band wheel connected thereto illustrating the mount for the drive shaft, with the parts directly associated with the drive shaft illustrated in section;

Figure 5 is an elevational view of the bull post;

Figure 6 is a sectional view along the line 5—6 of Figure 5;

Figure 7 is a sectional view along the line 7—7 of Figure 5;

Figure 8 is a diagrammatic view illustrating the spudding action in association with the spudding tool cable;

Figure 9 is a view similar to Figure 8 illustrating a rearrangement of the spudding action for the initial drilling stage;

Figure 10 is an elevational view of the pitman of the spudding action;

Figure 11 is a top plan view of the pitman;

Figure 12 is a sectional view along the line 12—12 of Figure 10;

Figure 13 is a detail view of the pivotal mount for the spudding action frame;

Figure 14 is a view illustrating a pump drive;

Figure 15 is a top plan view of a load frame designed to withstand heavy duty service;

Figure 16 is a top plan view of the spudding action; and

Figure 17 is a detail view of a pump attachment connected with a portion of the spudding action to operate in conjunction with the well being drilled, in contradistinction to the pumping attachment of Figure 14 which is employed for operating a pump in a well for supplying water for general operating purposes.

In the embodiment selected to illustrate my invention, I make use of a derrick 20 in which the derrick legs 22 are arranged in the usual converging relation and interconnected by structural members 24, as well as diagonal supports (not shown). The derrick is entirely conventional and need not be described in detail. Suffice it to say, the lower ends of the derrick legs

22 are connected with a sill frame 26 mounted on corner blocks 28, which in turn are mounted on subformation blocks 30 in the usual manner. Sill frame 26 carries the derrick floor 32.

Figure 4 illustrates the main drive shaft 34 as being rotatably supported in bearings 36, 38 and 40, with the bearings mounted on frame members 42, 44 and 46, respectively, the latter being more clearly illustrated in Figure 1. The band wheel 48 is keyed to the shaft 34 and may be operatively connected with an engine through the medium of a belt or other suitable coupling 50. Frame members 42, 44 and 46 are fixedly related to a skid frame 52 which is positioned on the derrick floor 32. Skid frame 52 includes I-beam members 54 which have their lower flanges extended beyond the webs of the beams and turned up at 56 to facilitate movement of the skid frame with respect to any obstruction which might lie in the path of the frame as it is being moved.

Sill frame 26 is made up of two I-beams 58 and two I-beams 60 which are bolted together at their corners, with the joined corners positioned on the corner blocks 28. Cross channels 62 and cross I-beams 64 have their ends bolted to the two I-beams 60 and constitute additional support for the derrick floor 32. The two I-beams 54 of the skid frame 52 are interconnected through the medium of three I-beams 66, 68 and 70, see Figures 3 and 4. Underneath the derrick floor 32 beneath the skid frame 52 I mount a reinforcing frame 72, which frame is illustrated in plan view in Figure 15. Reinforcing frame 72 includes a floating beam 74 which has its ends fixedly connected with the two beams 60 of the sill frame. Floating beam 74 is positioned midway between the two I-beams 64, and underneath and transversely of the two beams 64 I position a tie sill 76. Floating beam 74 and the tie sill 76 are illustrated as comprising I-beams. Referring to Figure 1, it will be noted that the floating beam 74 is spaced from the derrick floor 32 and the tie sill 76 is preferably located directly underneath the frame member 46, as illustrated in Figures 1 and 4.

Referring to Figure 15, diagonal brace members 78 interconnect the floating beam 74 with the beams or supporting sills 64 adjacent the latter's connection with the two sills 60. Hog rods 80 have their lower ends connected with plates 82 extending transversely adjacent the lower flange of the tie sill 76, and their upper ends are similarly connected with cross bars 84 adjacent the upper flange of the beam 70 of the skid

frame. Thus, tightening of the hog rods 80 will effectively anchor the skid frame to the derrick floor, with the I-beams 54 of the skid frame lying above and paralleling the two supporting sills 64. Hog rods 86 are associated with the I-beam 66 of the skid frame and one of the sills 60 in the same manner. Thus, each end of the skid frame 52 is effectively anchored, with its I-beam 66 lying above and paralleling the adjacent sill 60, as illustrated in Figure 4.

Heavy duty machinery is subjected to violent vibration as well as enormous lifting and depressing forces. Figure 1 illustrates the floating beam 74 as being spaced from the tie sill 76 as well as from the derrick floor 32. Thus, any lifting or depressing forces which tend to bend the two I-beams or sills 64 will tend to pull the two sills 60 together, but such movement of the sills is effectively resisted by reason of the floating beam 74 and the diagonal braces 78. Thus, the reinforcing frame 72 affords an efficient reinforcing structure for drilling apparatus which is subjected to extremely rough usage as well as burdened with the handling of enormous loads.

To the shaft 34 I key a friction wheel 88, which wheel includes wood or fibre lagging 90 and facing 92. Friction wheel 88 is arranged to be engaged by a bull wheel 94 fixedly related to the bull post shaft 96 having a trunnion 98 at one end rotatably journaled in a bearing 100 carried by a support 102 having its lower end bolted to one of the sills 60 and its upper end bolted to an I-beam 104 having its ends bolted to two of the derrick legs 22, see Figure 3. The opposite end of the bull wheel shaft 96 is provided with a trunnion 106 rotatably journaled in a bearing 108 carried by a bull post 110. The bull post may comprise an I-beam having its upper end bolted to the I-beam 134 and its lower end bolted to one of the sill members 58, see Figure 5.

Referring to Figures 5, 6 and 7, the web 112 of the bull post 110 is provided with a transverse slot 114 for slidably receiving the bearing 108, which bearing includes flanges 116 lying adjacent one face of the web 112 and slidably supported thereagainst by reason of retaining flanges 118 attached to the web by bolts 120. Because of the slot 114, I provide the bull post 110 with reinforcement 122, which may comprise channels riveted at 124 to the flanges of the bull post. A reinforcing plate 126 is also positioned adjacent the web 112 opposite the flange retainers 118, which plate is made secure by the bolts 120.

Rotation of the bull wheel shaft 96 is effected through movement of the bull wheel 94 into frictional contact with the friction wheel 88. Means for moving the bull wheel 94 comprises a swinging lever 128 having its upper end pivotally connected with a bolt 130 passing through one of the flange retainers 118, the web 112 and the reinforcing plate 126. The upper end of the swinging lever 128 is provided with a bore 132 for loosely receiving the bolt 130, and the bolt is provided with a nut 134 which holds the lever assembled with the bolt. Bearing 108 includes a trunnion 136 which extends loosely through an opening 138 in the swinging lever 128 a short distance inwardly of the bolt 130. The trunnion is threaded at 140 for the reception of a nut 142 which holds the lever assembled with the trunnion. In Figure 5, I illustrate the lower end of the swinging lever 128 as being pivotally connected at 144 with a reach 146 having its opposite end pivotally connected at 148 with an arm 150 fixedly related to a shaft 152, see Figure 1.

Shaft 152 is rotatably supported on the derrick floor 32 through the medium of bearings 154, and the shaft is provided with a lever 156, see Figures 2 and 3, through the medium of which the shaft may be rotated for bringing the bull wheel 94 into frictional engagement with the friction wheel 88.

Bull wheel 94 is spaced closely to the friction wheel 88 so as to require a slight shift only for bringing the two wheels into frictional relation. Arm 150 is relatively short so that an effective leverage is had on the reach 146, and the swinging lever 128 is pivotally connected with the trunnion 136 which is closely spaced from the bolt 130 which also provides an advantageous leverage for moving and holding the bull wheel against the friction wheel. Enormous forces are effective on the bull wheel shaft, which forces normally tend to swing the shaft for bringing the bull wheel into engagement with the friction wheel. When operating with the bull wheel in the clear of the friction wheel 88, the lever 156 may be suitably tied so as to prevent accidental shifting of the bull wheel, thus maintaining the latter in the clear of the friction wheel 88.

To the end of the bull wheel shaft 96 opposite the bull wheel 94 is connected a brake drum 158. A brake band 160 is arranged on the braking face of the drum and has one end provided with a loop 162 connected with the bight of a U-shaped support 164 anchored to angles 166 which may span one of the beams 64 and the adjacent beam 58. Figure 3 illustrates the brake band, and the opposite end of the band is looped at 168 for connection with a crank 170 pivotally mounted on the derrick floor 32 through the medium of bearings 172. The crank is connected with a handle 174 through the medium of which the brake band may be manipulated for controlling the bull wheel shaft. The bull wheel shaft carries a spool flange 176, see Figure 2, which flange is located intermediate the bull wheel 94 and the brake drum 158 so as to provide spool reaches 178 and 180 upon which the drill line or cable 182 is wound. Spool reach 178 carries a reserve supply of cable, and the flange 176 is slotted at 184 to permit transfer of cable from the spool reach 178 to the spool reach 180. The spool reach 180 carries a limited supply of cable which is being paid out and taken up during a given drilling operation.

During normal operation, the main drive shaft 34 is rotated in a clockwise direction, when viewing Figure 1, but counter-rotation of the shaft may be effected through the medium of a reversing mechanism associated with the engine which supplies power. Reversing mechanisms are employed in connection with internal combustion engines, but in connection with steam power, reverse rotation is of course effected through reversal of the engine. Reversing mechanisms are old and well known in the art.

Figure 8 illustrates the drill line 182 as being extended upwardly and passed over the crown sheave 186 carried by the crown block 188 which is mounted on the top of the derrick in the usual manner. From the crown sheave 186 the drill line extends downwardly, as at 188 in Figure 1, with the line reach 188 axially aligned with the well being drilled. Figure 1 illustrates the conductor section 190 which lines the well from the ground level to a limited depth, in addition to extending upwardly through the derrick floor 32, as illustrated in Figures 1 and 3.

Figure 1 illustrates a spudding action 192 in

association with the line reach 188, which action manipulates the line for drilling purposes. In connection with the use of spudding drills, the spudding drill does not normally rest on the bottom of the hole being drilled. Normally, the spudding drill is maintained at a predetermined distance from the bottom, and the drilling action is consummated through lifting the drill and then dropping the line. The weight of the spudding drill and the drill stem is such as to stretch the line sufficiently far to bring the drill forcibly against the bottom of the hole. The drill line is paid out in degrees as the depth of the hole increases. Action 192 manipulates the drill line for raising the drill tool and then suddenly dropping the line for impacting the tool against the bottom of the hole.

Figures 1 and 4 illustrate the shaft 34 as being provided with a crank arm 194 provided with a wrist pin 196 to which one end of a pitman 198 is connected. Figures 10 and 11 illustrate the pitman 198 as comprising sections 200 and 202 connected by bolts 204, so that the effective length of the pitman may be varied through relative adjustment of the sections 200 and 202. The latter is provided with a curved bearing part 206 and a latch bearing part 208 pivotally connected at 210. Figure 10 illustrates the parts 206 and 208 as embracing a bearing sleeve 212 mounted on the wrist pin 196, and the part 208 is fixedly related to the section 202 by a latch bar 214 hinged at 216 to the part 208 and provided with a hook 218 arranged to extend over the section 202 for holding the part 208 in place. A coiled spring 220 is arranged to bias the latch bar 214 to its normal position of Figure 12, but the latch bar may be swung to the dotted line position so as to permit the part 208 to be pivoted away from the section 202, thus permitting the pitman to be uncoupled from the wrist pin. Part 208 is provided with a grip 222, and the latch bar 214 is provided with grips 224 to facilitate manipulation of the parts.

The opposite end of the pitman includes a bearing 226 mounted on a shaft 228 mounted on a rocker arm 230 of the action bracket 232. Upon the shaft 228 I rotatably mount an action or spudding wheel 234 in the nature of a sheave which engages the reach 188 of the line 182. Action bracket 232 includes arms 236 keyed to a pilot shaft 238 upon which I mount a rotatable pilot wheel 240 in the nature of a sheave. The axis of the pilot wheel 240 remains fixed during the drilling operation, and the pilot wheel is so related to the hole being drilled as to bring its periphery into contact with the reach 188 of the drill line 182 when the line reach is in its straight phase, as illustrated in Figure 1. At no time is the axis of the pilot wheel shifted laterally during the spudding operation. The line is manipulated through the medium of the action wheel 234, and the action wheel is oscillated through oscillatory movement of the rocker arm 230 through the medium of the pitman 198 when the drive shaft 34 is rotated.

Figure 8 best illustrates the manner in which the cable is operated through the medium of the action 192. Crank arm 194 rotates in the direction of the arrow 242 and the rocker arm 230 oscillates for moving the action or spudding wheel 234 within the limits illustrated by full and dotted lines of the wheel. The spudding action 192 is located directly over the hole being drilled and the pilot wheel 240 is located so that when no pull is exerted on the cable by the action wheel 234, the run 188 of the line 182 hangs straight and is

exactly centered with respect to the hole. The full line illustration of wheel 234 in Figure 8 illustrates the wheel in one extreme position, at which time the cable run is pulled laterally for lifting the cable run and the attached drill and stem beneath the pilot wheel 240 the necessary distance so that when the action wheel 234 is oscillated back to the dotted line position, the drill will be dropped suddenly so as to stretch the cable and bring the drill into impacting relation with the bottom of the hole. Bull wheel shaft 96 is braked against rotation so as to positively restrain the cable from paying out. The cable is paid out through manipulation of the brake 160 as the depth of the hole progresses, but for impacting purposes the cable is braked against any paying out action so that the falling of the drill will stretch the cable.

Rocker arm 230 is so related to the pitman 198 as to impart a sudden movement to the rocker arm as it moves the wheel 234 from its full line illustration to the dotted line position of Figure 8. Thus the line is dropped suddenly to give the drill a sudden drop for effectively stretching the line. Sections 200 and 202 of the pitman are adjustably connected so that the effective length of the pitman may be accurately adjusted. Action wheel 234 and the pilot wheel 240 are so related as to maintain the cable run 188 on the sheaves during the drilling operation. Action 192 is located a short distance above the derrick floor 32 which permits the use of derricks of much shorter proportions than is common in the art. The action 192 is relatively simple and eliminates the cumbersome walking beam which is standard in the art. The pilot wheel 240 guides the run 188 so that it is perfectly centered with the hole being drilled at all times.

Figure 16 illustrates the offside location of the rocker arm 230 for "pulling out" purposes. Shaft 238 is rotatably journaled in bearings 244 and 246 mounted on a frame 248, see Figures 1, 3 and 13. The frame includes legs 250 and 252 which are inclined slightly to the vertical and interconnected by diagonal braces 254. Referring to Figure 13, the leg 250 is provided with a hinge part 256 which is pivotally connected with a hinge part 258 by a rod 260, which also connects the upper hinge part 262 with a companion hinge part 264. Hinge part 258 is bolted or riveted to one leg of the frame 44 at its lower end, and hinge part 264 is bolted or riveted to a channel 266 anchored to the upper margin of the frame 44. Hinge part 262 carries the bearing 246.

Leg 252 has its lower end bolted at 268 to one of the I-beams 54 of the skid frame, see Figure 3. The bearing 244 is mounted on the upper end of the leg 252, and the leg has fixedly related thereto channels 270 between which eye elements 272 are connected for the reception of an eye element 274 anchored to the frame 46, see Figures 1 and 2. A bolt 276 connects the eyes 272 and 274.

When "pulling out", the shaft 238 is moved longitudinally in the bearings 244 and 246 so as to bring the action 192 to one side of the hole, as illustrated in Figure 16. When the action 192 is being employed, the shaft 238 is in its normal positions of Figures 2 and 3, and relative endwise movement is restrained by reason of a pin 278 which is driven into a transverse bore in the shaft 238, see Figures 2 and 3. Figure 3 illustrates the bracket arms 236 as being so spaced with respect to the bearing 244 as to permit the necessary relative axial shift of the shaft 238.

While the apparatus so far described has been illustrated in connection with the action 192 for manipulating a spudding drill, provision is made for the use of a rotary drill unit. The rotary drill unit is indicated generally in dotted lines at 280 in Figure 2. Such rotary units are old and well known in the art and need not be described in further detail. Suffice it to say that the rotary unit is positioned on the derrick floor 32 and aligned with the hole being drilled. To accommodate the rotary unit 280, provision is made for swinging the action 192 to one side, as illustrated in dotted lines in Figure 2. Shifting of the action 192 is accomplished through removal of the bolts 268 of Figure 3 and pivoting the action together with the shaft 238 about the axis of the rod 260. Leg 252 will support the free end of the shaft 238 and the action 192 when swung to one side, although it might be desirable to place a supporting block between the lower end of the leg and the derrick floor 32.

For "spudding in" purposes, the action 192 is also swung to the dotted line position of Figure 2. Spudding drills are associated with a drill stem of considerable length, and in starting the hole the stem would interfere with the action 192 in the arrangement of Figure 8 when positioned over the hole. For "spudding in" purposes, the pitman 198 is disconnected from the wrist pin 196 and the pilot wheel 240 is mounted on the wrist pin. Thus, the pilot wheel 240 is directly connected with the crank arm 194 and the cable 182 is passed underneath the pilot wheel, with the cable run 188 depending unrestricted from the crown sheave 185. Thus, accommodation is provided for the drill and its stem during the initial drilling operation for sinking the hole to such a depth as to provide accommodation for the drilling action 192, as illustrated in Figure 8. Figure 9 illustrates the action of the pilot wheel 240 on the cable 182 for raising and lowering the drill line.

Power to operate the rotary unit 280 is derived from a shaft 282, which shaft may comprise the pinion shaft of the unit. Figure 2 illustrates the shaft 282 as being rotatably journaled in bearings 284 mounted on supports 286 bolted at 288 to the derrick floor 32. A sprocket 290 is keyed to the shaft 282 and may be connected with a chain 292, indicated in dotted lines in Figure 2, which passes over a sprocket 294 rotatably mounted on the main drive shaft 34, see Figure 4. Sprocket 294 may be provided with dogs 296 to mesh with clutch dogs 298 on a collar 300 keyed to the drive shaft. A lever 302 is connected with the collar for shifting the same longitudinally of the main drive shaft 34 into and out of engagement with the dogs 296. Lever 302 is pivotally connected at 304 to a support 306 bolted to the beams 66 and 68, with the lower end of the lever pivotally connected at 308 with a rod 310 connected with a lever 312 pivotally mounted on a support 314. Thus, the sprocket 294 may be driven by the main drive shaft 34 independently of the friction wheel 88.

Sprocket 294 also serves as a drive for the sprocket 316 associated with the calf wheel 318 through the medium of a chain 320, see Figures 1 and 2. Calf wheel 318 is provided with a brake band 322 which may be operated by a brake lever (not shown), but which may be of the type illustrated at 174 in connection with the brake band 160 associated with the brake drum of the bull wheel shaft. Calf wheel 318 is provided with a spool shaft 324 provided with a spool flange 326

including a line transfer slot 328. The spool is rotatably journaled in bearings 330 mounted on posts 332. The purpose and operation of calf wheels are well known in the art.

Upon the main drive shaft 34 I mount a cat winch 334, see Figure 4, which cat winch is provided with brake drums 336. Brake bands 338 are associated with the brake drums 336, and one end of each brake band is connected to a support 340 mounted on supporting channels 342, see Figure 1. Supporting channels 342 may be bolted to the cross members 344 bolted to the frames 44 and 46. The other ends of the brake bands 338 are connected with arms 346 fixedly related to a bar 348 rotatably journaled in bearings 350 mounted on the members 344, see Figures 1 and 4. Bar 348 is connected with an arm 352 pivotally connected with one end of a link 354 having its other end pivotally connected with an arm 356 fixedly related to a shaft 358 rotatably journaled in bearings 360 bolted to the derrick floor 32, see Figures 1 and 2. Shaft 358 terminates in an upstanding lever 362 through the medium of which the shaft may be rotated for actuating the brake bands 338, see Figures 2 and 4.

Cat winch 334 includes a dog clutch part 364 arranged to be engaged by a dog clutch collar 366 splined to the main drive shaft 34 and connected with a lever 368 pivotally connected at 370 with the support 306, see Figure 4. The lower end of the lever 368 is pivotally connected with a rod 372 pivotally connected at its opposite end with a lever 374, see Figure 4. Thus, the cat winch 334, which is loosely mounted on the main drive shaft 34, may be fixedly related to the drive shaft for rotation therewith through actuation of the lever 374.

The cat winch 334 includes a spool flange 376 which is also provided with a line transfer slot 378, see Figure 2. Spool 380 of the cat winch constitutes a supply for the line which may be transferred onto the operating spool 382. During operation, an occasion might arise in which the line paid out from the operating spool 382 is not in proper alignment with the hole being drilled. The cat winch is located somewhat to one side of the hole being drilled, and to provide proper alignment for the line, the service spool 382 of the cat winch may be provided with facing 384 which may be made sectional and secured to the spool by means of bolts 386, see Figure 4. The facing is tapered for bringing the spooled line into proper alignment.

A sand reel 388 is rotatably journaled in bearings 390 mounted on supports 392, one of which is illustrated in Figure 1. These supports may be bolted to the frames 42, 44 and 46. Sand reel 388 includes a flange 394 provided with a line transfer slot 396 to provide a supply spool 398 and a service spool 400. Brake bands 402 pass about drums 404 each having an end connected with an eye bolt 406 anchored to a bracket 408 bolted to one of the I-beams 54, see Figure 1. The opposite ends of the brake bands are connected with arms 410 fixedly related to a shaft 412 rotatably journaled in bearings 414 bolted to the brackets 408, see Figures 1 and 2. Shaft 412 terminates in a lever 416 additionally supported by a bracket 418 bolted to the derrick floor 32, see Figures 2 and 3. Figure 3 illustrates the control levers 156, 154, 312, 362, 374 and 416 as being closely grouped so as to be readily accessible by the operator from a given position on the derrick floor.

In drilling in some localities, it is necessary to provide a well for supplying water to the job. It is common practice to dig a well and employ a pump for lifting the water. In Figures 2 and 14, I illustrate a well casing 420 and a pump rod 422 in association with a packing gland 424, which well casing is located a short distance to one side of the gas or oil well being drilled. Pump rod 422 is connected with a run of chain 426 having its end 428 fixed to a segmental sprocket 430 which includes a split hub 432 keyed at 434 to the pilot shaft 238, and additionally clamped on the shaft by a bolt 436. Thus the shaft 238, which is reciprocated through the action of the line run 188 being manipulated by the action 192, oscillates the segmental sprocket 430 for reciprocating the pump rod 422.

Figure 17 illustrates a sprocket 438 as being mounted on the pilot shaft 238 and the adjacent arm 236 of the rocker arm 230 is bored for the reception of a U-bolt 440 which passes over one spoke of the sprocket for fixedly relating the same to the arm 236, so that the sprocket will be oscillated through oscillatory movement of the rocker arm. A pitman 442 is made up of sections 444 and 446 adjustably connected together by bolts 448, with the section 444 terminating in an eye 450 for the reception of a bolt 452 connected with the rocker arm 230. The rocker arm may be provided with a series of openings 454 for selective reception of the bolt 452 so as to vary the effective length of the rocker arm for oscillating the sprocket 438. Figure 17 illustrates the crank arm 194 as also being provided with a series of openings 456 for the selective reception of the wrist pin 458.

A run of chain 460 has one end fixedly related to the sprocket 438 by a U-bolt 462, and the other end of the chain is connected with a pump rod 464 passing through a packing gland 466 which may be associated with the upper end of the well casing 468. Pump rod 464 is actuated for oil pumping purposes in the drilled hole. In an arrangement according to Figure 17, the sprocket wheel 438 is substituted for the pilot wheel 240, and the pitman 442 is substituted for the pitman 198 so as to secure a shorter pitman reach which renders the rocker arm 230, in combination with the sprocket 438, operable for pumping purposes.

To the main drive shaft 34 I key a sprocket 470, see Figure 4, for connection with a chain 472 which passes over a sprocket 474 for driving the sand reel 388, see Fig. 2. One of the brake drums 404 is provided with a clutch 476 through the medium of which the sand reel may be rotated. Clutch 476 is preferably connected with the shaft 412 of the sand reel braking lever 416 so as to permit actuation of the clutch. Thus, in one position of the lever 416, the clutch will be engaged, while in another position the clutch will be disengaged and the brake applied. Such mechanisms are well known in the art and need not be described in further detail.

My invention is designed to handle all jobs which might arise in connection with digging wells of the oil and gas type. The apparatus is compactly arranged so as to require a relatively small amount of derrick floor space, and the controls for the different operating units are advantageously located so as to be within easy reach of the operator. For cable tool drilling, the action 192 operates the cable in such a manner as to actuate the drill with a rapid release. Rocker arm 230 is connected with the crank arm of the main drive shaft 34 through the medium of a

pitman of such length as to cause the crank to impart a rapid action to the rocker arm when the line is released for dropping the drill.

Action 192 is located directly over the hole being drilled, and elimination of the conventional beam simplifies the drilling procedure. The apparatus is assembled as a unit and requires about one-fourth of the derrick floor space of conventional beam apparatus. The apparatus eliminates the necessity of putting in "back twist" to keep the line from kinking above the usual clamps, in addition to eliminating inconveniences experienced in running pipe. The apparatus is more easily portable than the conventional systems now in use.

The foundation frame is designed to support heavy loads and the floating beam arrangement reinforces the general frame structure so as to withstand heavy duty service. Action 192, in being located directly over the hole, distinguishes from spudder devices which operate over the rig. My action eliminates the tight and loose hitches common in the art of drilling wells, and the bull wheel may be easily controlled to pull up the line as easily as to lend slack thereto. Thus, I facilitate the manipulation of fishing tools and make it possible to "jar up" the hole as fast as the tools come loose. Since there is no slack line hanging over the rig, I eliminate the necessity of putting in "back twist." Accommodation is provided for the use of a rotary apparatus.

Having thus described certain embodiments of my invention in detail, it is, of course, understood that I do not desire to limit the scope thereof to the exact details set forth except in so far as those details may be defined in the appended claims.

I claim:

1. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line, and means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for periodically exerting a lateral pull on the drill line and releasing the same, to raise and lower the line run connected with the drill.

2. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line over the hole being drilled, and means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for looping the drill line and releasing the same, to raise and lower the line run connected with the drill.

3. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line over the hole being drilled, and means for paying out the drill line as the depth of the well increases, said spudding action including a pilot element and an action element located between the pilot element and the crown sheave for looping the drill line and releasing the same, to raise and lower the line run connected with the drill.

4. In a drilling apparatus, the combination of

a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line, and means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for periodically exerting a lateral pull on the drill line and releasing the same, to raise and lower the line run connected with the drill, said pilot wheel holding the line run connected with the drill centered with respect to the hole being drilled in all positions of the action wheel.

5. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the crown sheave for connection with a drill, a drive shaft, a rocker arm having an action element carried thereby, a pilot wheel mounted for rotation about the axis of the rocker arm, a crank connected with the drive shaft, and a pitman connection between said crank and the rocker arm for oscillating the latter, said action element being located between the pilot wheel and the crown sheave and being moved by the rocker arm for periodically looping the drill line and releasing the same, to raise and lower the line run connected with the drill.

6. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for periodically exerting a lateral pull on the drill line and releasing the same, to raise and lower the line run connected with the drill, a derrick for supporting the crown sheave, a foundation for the derrick, including a sill frame, and a reinforcing frame operatively connected with the sill frame, said reinforcing frame including a floating beam structure cooperable on certain sills in said sill frame to resist buckling of the same.

7. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line over the hole being drilled, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot element and an action element located between the pilot element and the crown sheave for looping the drill line and releasing the same, to raise and lower the line run connected with the drill, a cat winch mounted on said drive shaft, and clutch and brake means for said cat winch.

8. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line over the hole being drilled, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot element and an action element located between the pilot element and the crown sheave for looping the drill line and releasing the same, to raise and lower the line run connected with the drill, a sand reel, and an operating drive between the sand reel and said drive shaft.

9. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the

sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line over the hole being drilled, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot element and an action element located between the pilot element and the crown sheave for looping the drill line and releasing the same, to raise and lower the line run connected with the drill, a cat winch mounted on said drive shaft, a brake for the cat winch, clutch means for operatively connecting and disconnecting the cat winch with respect to the drive shaft, and a sand reel operatively connected with said drive shaft.

10. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line over the hole being drilled, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot element and an action element located between the pilot element and the crown sheave for looping the drill line and releasing the same, to raise and lower the line run connected with the drill, a cat winch mounted on said drive shaft, a brake for the cat winch, clutch means for operatively connecting and disconnecting the cat winch with respect to the drive shaft, a sand reel operatively connected with said drive shaft, and a calf wheel operatively connected with said drive shaft.

11. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for periodically exerting a lateral pull on the drill line and releasing the same, to raise and lower the line run connected with the drill, said means including a bull wheel shaft upon which the drill line is wound and a friction wheel fixedly related to the bull wheel shaft, a friction wheel fixedly related to the drive shaft, and means for bringing the friction wheel of the bull wheel shaft into frictional engagement with the friction wheel on the drive shaft.

12. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for periodically exerting a lateral pull on the drill line and releasing the same, to raise and lower the line run connected with the drill, said means including a bull wheel shaft upon which the drill line is wound and a friction wheel fixedly related to the bull wheel shaft, a friction wheel fixedly related to the drive shaft, means for bringing the friction wheel of the bull wheel shaft into frictional engagement with the friction wheel on the drive shaft, and brake means for the bull wheel shaft.

13. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft,

a spudding action operatively connected with the drive shaft and the drill line, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for periodically exerting a lateral pull on the drill line and releasing the same, to raise and lower the line run connected with the drill, said means including a bull wheel shaft upon which the drill line is wound and a friction wheel fixedly related to the bull wheel shaft, a friction wheel fixedly related to the drive shaft, means for bringing the friction wheel of the bull wheel shaft into frictional engagement with the friction wheel on the drive shaft, brake means for the bull wheel shaft, a cat winch mounted on said drive shaft, clutch means for operatively connecting the cat winch with the drive shaft, and a brake for the cat winch.

14. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for periodically exerting a lateral pull on the drill line and releasing the same, to raise and lower the line run connected with the drill, said means including a bull wheel shaft upon which the drill line is wound and a friction wheel fixedly related to the bull wheel shaft, a friction wheel fixedly related to the drive shaft, means for bringing the friction wheel of the bull wheel shaft into frictional engagement with the friction wheel on the drive shaft, brake means for the bull wheel shaft, a cat winch mounted on said drive shaft, clutch means for operatively connecting the cat winch with the drive shaft, a brake for the cat winch, a sand reel, a clutch actuated drive for connecting the sand reel with said drive shaft, and a brake for the sand reel.

15. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for periodically exerting a lateral pull on the drill line and releasing the same, to raise and lower the line run connected with the drill, said means including a bull wheel shaft upon which the drill line is wound and a friction wheel fixedly related to the bull wheel shaft, a friction wheel fixedly related to the drive shaft, means for bringing the friction wheel of the bull wheel shaft into frictional engagement with the friction wheel on the drive shaft, brake means for the bull wheel shaft, a cat winch mounted on said drive shaft, clutch means for operatively connecting the cat winch with the drive shaft, a brake for the cat winch, a sand reel, a clutch actuated drive for connecting the sand reel with said drive shaft, a brake for the sand reel, and a calf wheel operatively connected with said drive shaft.

16. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave

for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line over the hole being drilled, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for looping the drill line and releasing the same, to raise and lower the line run connected with the drill, and a pivoted frame for supporting the spudding action, to permit the spudding action to be swung to one side of the hole being drilled.

17. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line over the hole being drilled, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for looping the drill line and releasing the same, to raise and lower the line run connected with the drill, and means for slidably mounting the spudding action, to permit the latter to be shifted to one side of the hole being drilled.

18. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line over the hole being drilled, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for looping the drill line and releasing the same, to raise and lower the line run connected with the drill, said spudding action including a rocker arm for supporting the action wheel, a crank fixedly related to the drive shaft and provided with a wrist pin, a pitman connecting the wrist pin with the rocker arm, said action wheel being detachably connected with the rocker arm, and said pilot wheel being detachable for connection with said wrist pin for actuating the drill line for spudding in the hole.

19. In a drilling apparatus, the combination of a crown sheave, a drill line passing over the sheave for connection with a drill, a drive shaft, a spudding action operatively connected with the drive shaft and the drill line over the hole being drilled, means for paying out the drill line as the depth of the well increases, said spudding action including a pilot wheel and an action wheel located between the pilot wheel and the crown sheave for looping the drill line and releasing the same, to raise and lower the line run connected with the drill, said spudding action including a rocker arm for supporting the action wheel, a crank fixedly related to the drive shaft and provided with a wrist pin, a pitman connecting the wrist pin with the rocker arm, said action wheel being detachably connected with the rocker arm, said pilot wheel being detachable for connection with said wrist pin for actuating the drill line for spudding in the hole, a shaft for pivotally mounting the rocker arm, said pilot wheel being rotatably connected with said shaft, a pump arm connected with said last-named shaft, a rotary drill unit shaft, and means for operatively connecting the rotary drill unit shaft with said drive shaft.

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