No. 668,209. Patented Feb. 19, 1901.

C. D. PIERCE.

DEEP WELL DRILLING APPARATUS.

(No Model.) (Application filed Apr. 18, 1899.)

Fig. 6

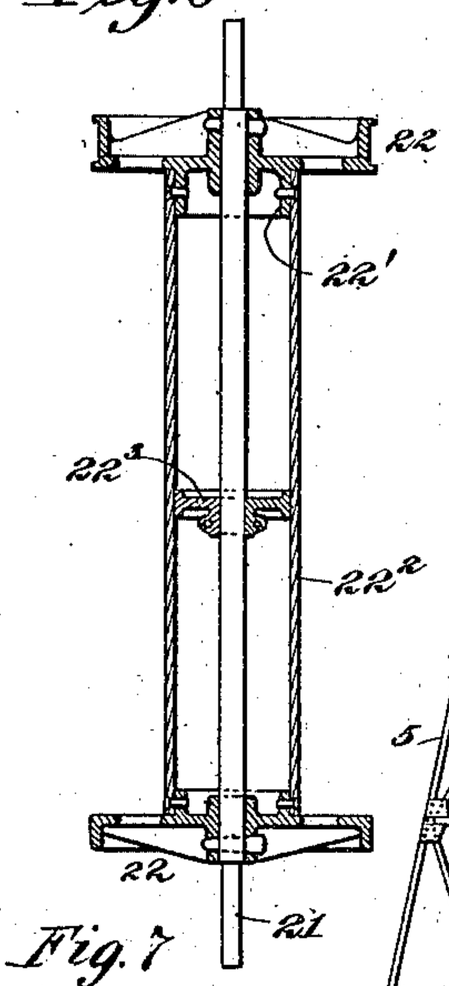

Fig. 2

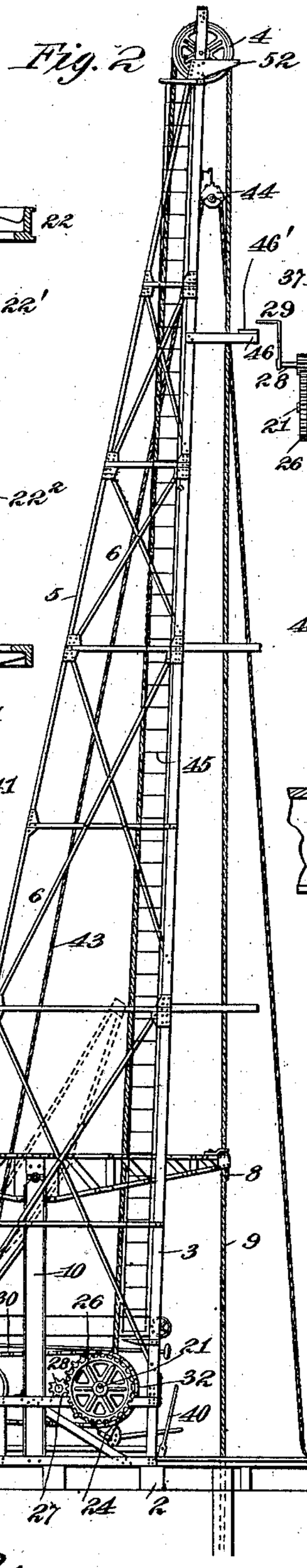

Fig. 3

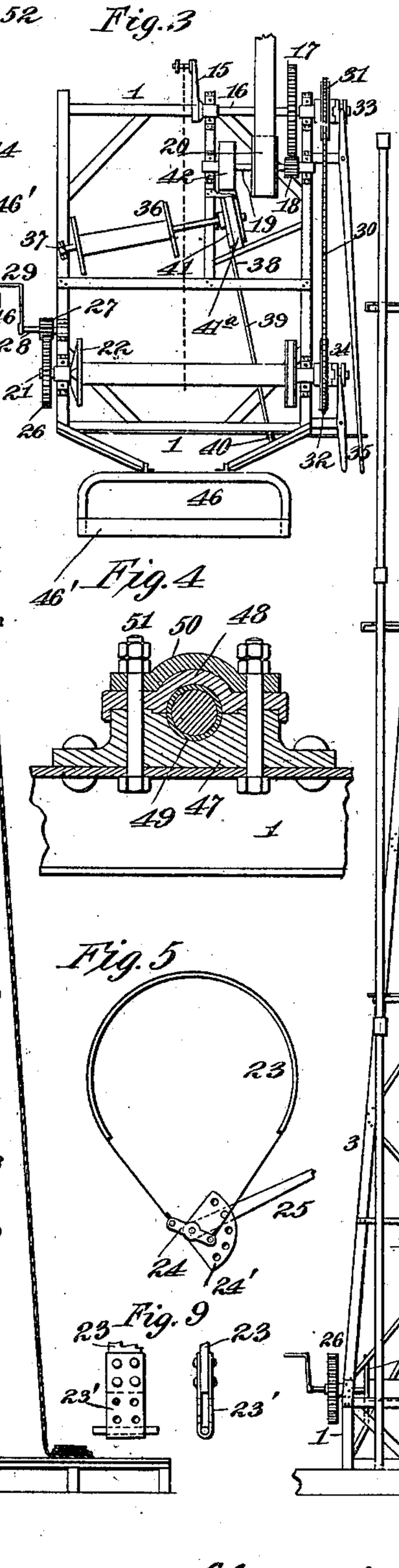

Fig. 1

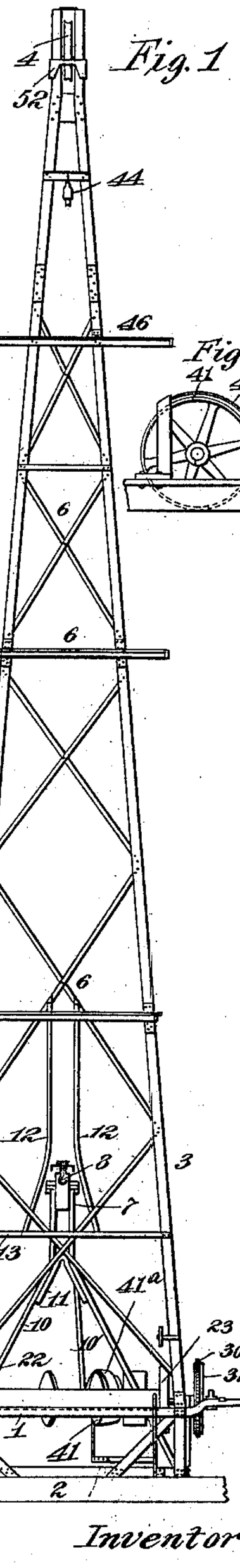

Fig. 8

Fig. 4

Fig. 7

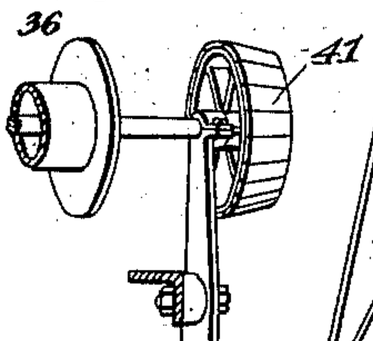

Fig. 5

Fig. 9

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UNITED STATES PATENT OFFICE.

CHARLES DENIO PIERCE, OF JERSEY CITY, NEW JERSEY.

DEEP-WELL-DRILLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 668,209, dated February 19, 1901.

Application filed April 18, 1899. Serial No. 713,466. (No model.)

To all whom it may concern:

Be it known that I, CHARLES DENIO PIERCE, a citizen of the United States, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Deep-Well-Drilling Apparatus, of which the following is a specification.

My invention relates to certain improvements in deep-well-drilling apparatus commonly known as "drilling-rigs," and particularly to improvements in that type of rig wherein a walking-beam is employed for the purpose of reciprocating the drilling-tools in the well. Prior to my invention these rigs were composed, essentially, of an upright wooden tower, vertically within which extended the drilling-cable and which was of sufficient height to permit the usual drilling-tools, sucker-rods, tubing, casing, &c., to be elevated entirely out of the well after the completion of the operation or before the operation of the sand-pump. The employment of a wooden tower of this character is objectionable, owing to the expense and time required in erecting it and to the great bulk necessitated in shipment. Moreover, the elevation of the tools, &c., from the well into the space inclosed by the tower materially curtails the available working room within it. In such prior devices the walking-beam was mounted on a samson-post, the latter consisting generally of a single wooden support which required to be carefully mortised into the sill and to be firmly braced by supports. This arrangement was clumsy, crude, ineffective, and liable to become loose at the joints. With such prior devices the walking-beam was oscillated from a crank operated from a large band-wheel, generally ten or twelve feet in diameter, to which power was communicated by a belt from the driving-engine. The employment of a large band-wheel of this character was considered necessary in order that the requisite power might be transmitted to the walking-beam, but is objectionable owing to the expense and bulk of the band-wheel. With such prior devices a bull-wheel shaft carrying two bull-wheels was employed for receiving the drilling-cable and for winding it up when desired to elevate the tools, &c., this shaft being operated by a bull-rope from a tug-pulley on the band-wheel shaft. When it was desired to operate the bull-wheel shaft, the bull-rope was applied, and when the tools had been withdrawn and brought up to the surface the bull-rope was thrown off, the tools, &c., being allowed to return to the bottom of the well by their weight, being retarded in their descent by applying a brake to one of the bull-wheels. Obviously these devices were crude and imperfect. Moreover, the operation of controlling the bull-wheels to permit the return of the tools, &c., was always a dangerous one, since in case of a failure of the brake to operate properly the speed of the bull-wheels, resulting from the descent of the tools, &c., would develop sufficient centrifugal action to destroy them. With the prior devices the sand-reel shaft was mounted at one side and carried a friction-pulley adapted upon the swinging of the shaft to engage frictionally with the band-wheel, whereby the sand-pump, having descended to the well by its weight, could be positively withdrawn. This arrangement also was objectionable in practice, principally because of the additional dimensions necessary in the foundation to support the sand-reel shaft.

Without enumerating any further the disadvantages inherent in drilling-rigs as constructed and operated for many years prior to my invention it is sufficient to say that such devices were crude, imperfect, cumbersome, expensive, inefficient, and short-lived.

In my improved rig I construct a tower of metal, preferably steel, elements of suitable cross-section, preferably angle-irons, which tower is carried on a strong but light and relatively compact steel or iron foundation-frame carried on wheels or on mud-sills when necessary. This steel or metal tower is very much lighter than the usual wooden tower, can be erected in only a fraction of the time required to set up the latter, and occupies a very much reduced bulk in shipment. My improved steel tower, instead of being made symmetrical, as were the wooden towers, and of a general pyramidal shape, is, viewed from the side, of the form generally of a right-angle triangle, the altitude of the triangle being inclined slightly from the vertical, whereby the drilling-cable, instead of passing down

within the tower, extends in front thereof. Thus when the tools, sand-pump, &c., are elevated from the well they can be moved so as to be entirely clear of the operators. Also by reason of this form the tools, sucker-rods, tubing, and casing may be supported upright against the tower without requiring any change therein.

I make my walking-beam in the form of a latticed steel frame, thus securing lightness and strength, and mount it on a samson-post of novel construction. This samson-post is composed of two (preferably) channel-irons extended at their bottom in a general A shape, with the feet secured firmly to the steel base and at the apex being arranged substantially parallel to receive the walking-beam. A samson-post constructed in this way is very rigid and cannot become loosened by any of the ordinary exigencies of use. The walking-beam at its forward end operates between guides, which constitute a part of the tower, and plays above a cross-brace, also constituting a part of the tower and which forms an effective and efficient substitute for the usual headache-post.

My band-wheel, which operates the crank for reciprocating the walking-beam, is mounted on a counter-shaft carrying a pinion for driving the large gear on the crank-shaft, both the counter-shaft and crank-shaft being carried on the same base which supports the tower. In this way I dispense with the usual enormous band-wheel, while at the same time the general portability of the device is preserved.

My bull-wheel shaft is carried in the frame-work and is on the same side of the drilling-cable as the band-wheel, in which respect my device is distinguished from the usual wooden rigs and is an improvement over them because of the general accessibility of this feature. Instead of employing a bull-rope operated in the crude manner explained to rotate the bull-wheel shaft when desired I employ a sprocket-chain connecting the sprocket-wheels on the crank-shaft and bull-wheel shaft, respectively. Each of these sprocket-wheels is provided with a clutch for throwing it out of action when desired. The bull-wheels which I use are relatively compact in diameter and are not provided, as was the case formerly, with pins on their periphery to enable them to be turned manually. Instead of this arrangement I provide the bull-wheel shaft with a gear with which a pinion on a counter-shaft engages, whereby the bull-wheel shaft may be operated by hand when desired for taking up the slack in the cable. The pinion is movable out of engagement with the gear when the bull-wheel shaft is to be operated by power to elevate the tools or other devices.

With my device the sand-reel is mounted, in common with the other elements, upon the steel or iron frame and is arranged to be thrown into and out of engagement with a separate friction-wheel on the power-driven counter-shaft. This arrangement is better and more compact than the old arrangement.

Danger has been experienced in the operation of drilling-rigs in the liability of the caps of the several bearings becoming dislodged under the upstrains imposed on the bull-wheel shaft and crank-shaft by the weight of the tools. In my improved device I make use of bearing-boxes for the bull-wheel shaft and the crank-shaft which are of such a character that accidents of this kind cannot occur.

In order that my invention may be better understood, attention is directed to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a front elevation of my improved apparatus; Fig. 2, a side view of the same; Fig. 3, a plan view; Fig. 4, a vertical section of the preferred form of bearing-boxes used for the crank-shaft and bull-wheel shaft; Fig. 5, a detail view of the bull-wheel brake-band and its adjusting and operating devices; Fig. 6, a longitudinal section of the bull-wheel; Fig. 7, a detail view of one end of the sand-pump-line reel; Fig. 8, a detail view of the sand-pump-line-reel-shaft friction-pulley, showing the back brake; and Fig. 9, detail views of the auxiliary adjusting device for the brake-band.

In all of the above views corresponding parts are represented by the same numerals of reference.

The base is formed of steel elements 1 1, constituting an essentially box-like or rectangular structure, which may be carried on mud-sills 2 when necessary or upon a specially-constructed wagon. By reason of the portable character of my rig I am enabled to thus support or transport rigs of much greater capacity than have been heretofore capable of being mounted on wheels. Extending up from the base 1 are the elements constituting the tower and comprising the two legs 3 3, secured at their lower ends to the upper front edges of the base, said legs extending upwardly toward each other and slightly outward over the perpendicular. The legs 3 3 carry the crown-pulley 4 between their upper extremities. The other main elements of the tower comprise the two supplemental braces 5 5, extending upward from the base from a point near the rear edges thereof and joining the legs 3 3 near the upper ends of the latter. Suitable cross-braces 6 6 are employed at the proper points to secure rigidity and strength. The tower thus formed is preferably composed of angle-irons riveted or bolted together, and it is of such a character that it can be set up in a relatively short time compared to that required to erect a wooden rig.

I do not claim herein the specific construction of the tower and of its base or bed, and therefore do not illustrate nor describe its detailed construction. In a separate application I describe, illustrate, and claim these features of invention specifically.

The walking-beam 7 is composed, prefer-

ably, as shown, of a steel or iron latticed frame, its forward end carrying the walking-beam hook 8, to which is secured the usual temper-screw for attachment to the drilling-cable 9. The walking-beam 7 is mounted in a samson-post comprising the two steel or iron elements 10 10, preferably channel-irons. These irons extend outward at their lower ends to form a general A shape, permitting the passage of the jerk-line for starting the hole, as shown in dotted line, Fig. 3, and converge upward, being bolted to two T's 11 of the proper form. Above T's 11 the irons 10 10 extend generally parallel for receiving the bearing for the walking-beam 7. The forward end of the walking-beam works between two guides 12 12, which form a part of the tower, and above a cross-beam 13, which constitutes an effective substitute for the usual headache-post. The guides 12 12 are spread apart at the bottom to permit the passage of the temper-screw when the walking-beam is being tilted near the vertical, as will be explained. The walking-beam is reciprocated by a pitman 14, operated from a crank 15, mounted on a crank-shaft 16. This shaft carries a gear 17, with which a pinion 18 is in mesh, the latter pinion being carried on a counter-shaft 19, operated from a band-wheel 20 of relatively small size. By driving the crank-shaft 16 from a counter-shaft, as shown, I am enabled to dispense with the enormous band-wheels now employed without any sacrifice of the effective power imposed on the walking-beam.

The bull-wheel shaft 21 is mounted in bearings in the framework 1, and instead of being provided with the usual large bull-wheels is provided with the relatively small flanges 22, which guide the drilling-cable on the bull-wheel shaft. One of said flanges is made of increased width and receives a band-brake 23, the ends of which are connected to a pivoted lever 24, adapted to be oscillated by a foot-lever 25, so as to tighten up the band 23 at both ends, thus securing an effective and powerful braking action. If desired, the other flange of the bull-wheel shaft may be provided with a corresponding brake to meet all emergencies. The preferred construction of bull-wheel is shown in Fig. 6, wherein the bull-wheels 22 are secured rigidly to the shaft by keys, said bull-wheels each having an integral shoulder 22′, to which is bolted a tubular body 22^2, forming the bull-wheel shaft from which the cable is wound. When great strength is desired, one or more supporting-webs 22^3 may be employed for sustaining the tubular body at one or more intermediate points. For convenience in transportation, &c., the bull-wheels are preferably made in sections and bolted together. Preferably an adjusting-quadrant 24′ is connected rigidly to the lever 24 and is adapted to be connected to the foot-lever 25 by a pin or bolts engaging one of a series of holes in said quadrant. By changing the hole in which the pin or bolt is inserted relative adjustment of the levers 24 and 25 is effected, whereby wear on the brake may be compensated. Referring to Fig. 9, the brake-band 23 is secured by bolts or rivets at one of its ends between the strap 23′, which is engaged with one of the pins on the lever 24. The strap 23′ is provided with holes, through which the rivets pass and which, as shown, are so arranged as to permit of a further adjustment of the brake-band when it is desired to take up slack. In order that the bull-wheel shaft may be turned by hand for any desired purpose, I provide it with gear 26, with which a pinion 27 meshes, the latter being carried on a shaft 28 operated by a crank 29. The pinion 27 is splined on the shaft 28 and can be thrown out of mesh with the gear 26 when desired. The bull-wheel shaft 21 is operated from the crank-shaft 16 by a sprocket-chain 30 engaging the sprocket-wheels 31 and 32 on the crank-shaft and bull-wheel shaft, respectively. Two clutches 33 and 34 are employed to connect the sprocket-wheels 31 and 32 with their respective shafts when it is desired to operate the bull-wheel shaft positively. The clutches 33 and 34 are operated by suitable levers 35 within easy reach of the operator.

The sand-pump-line reel 36 is mounted upon the frame 1 in a bearing 37 at one end and in a swinging lever 38 at the other, said lever being operated by a connecting-rod 39 from the hand-lever 40. The sand-reel shaft 36 carries a wood-lagged friction-wheel 41 thereon, adapted to engage with a friction-wheel 42 on the counter-shaft 19, which shaft turns at a relatively high speed, whereby the sand-reel will be correspondingly operated. The sand-pump line 43 extends from the sand-reel 36 over the sand-reel pulley 44, secured near the top of the tower below the crown-pulley 4. The sand-reel is provided with the sheet-iron back brake 41^a, secured rigidly to the frame, with which the pulley 41 is adapted to engage when it is swung out of engagement with the pulley 42.

Preferably I employ a ladder 45, extending up the tower, and I make use of an angle-bar 46, secured to the front legs 3 3 of the tower some distance below the sand-reel pulley 44, whereby a foothold will be offered to the operator for any desired purpose. The angle-bar 46 is bent in a general curved shape, as shown, and may, if desired, be provided with one or more planks 46′, extending across it, as shown, to constitute a secure and sufficiently roomy platform. This platform may be hinged so that it can be tilted to a vertical position. By making said bar of the general curved shape shown it offers an effective support for the sucker-rods, tubing, and casing when withdrawn. In order to more effectively support the sucker-rods, tubing, and casing, one or more of the horizontal cross-braces 6 are extended outward, as shown, whereby the sucker-rods or other devices when withdrawn

out of the well may be sustained against these extensions and the angle-bar 46, as I show in Fig. 1. These devices may therefore be effectively sustained at several points of their length, whereby any tendency to buckle or bend is overcome.

In the operation of elevating the tools, &c., from the well the entire weight of the tools or other devices is imposed on the bull-wheel shaft, exerting an enormous upward stress, and in the ordinary operation of drilling on the downstroke of the pitman 14 a corresponding stress is imposed on the crank-shaft 16. Accidents have frequently happened, caused by the breaking of the bearings of these shafts under these strains. In order to overcome any possibility of breaking, I prefer to employ bearings of the character shown in Fig. 4. Each of these bearings is formed with a lower pedestal portion 47, secured to the framework 1, and with the usual cast-iron cap 48, the cap and pedestal being babbitted at 49, as is common. Secured above the cap 48 is a steel clamping-piece 50, held in place by bolts 51, which pass all the way through the bearing into the framework. The advantage of this construction will be obvious.

The operation of my improved rig is as follows: In drilling the clutches 33 and 34 are disconnected, a suitable slack or bight in the drilling-cable is extended beyond the bull-wheel shaft, the temper-screw (not shown) is secured to the cable and is itself attached to the walking-beam hook, and the engine is started to drive the band-wheel 20. Rotation of the band-wheel shaft operates the crank-shaft 16 and reciprocates the walking-beam to perform the drilling operation, as is common. When it is desired to elevate the tools or other elements, the pitman 14 is disconnected from the crank 15, whereby the walking-beam may be tilted into an approximately vertical position, as shown in dotted lines, to clear the cable as it extends up from the tubular body 22^2 of the bull-wheel, thus permitting the cable to be wound over the entire length of said body between the disks 22 22, and the clutches 33 and 34 are operated to connect the sprocket-wheels 31 and 32 with the crank-shaft and bull-wheel shaft, respectively. The rotation of the shaft 16 turns the bull-wheel shaft to wind up the drilling-cable, and as soon as the latter is taut between the crown-pulley and the tools the temper-screw is disengaged from the cable and the tools drawn up. If now it is desired to operate the sand-pump, the latter is dropped down the well, descending by its weight against the resistance of the back brake and unwinding the sand-pump line from the sand-reel shaft. When the sand-pump reaches the bottom of the well, the lever 40 is operated to engage the friction-wheels 41 and 42 together, resulting in the reverse rotation of the sand-reel to wind up the sand-pump line. If it is desired to operate the bull-wheel shaft manually, this is accomplished by engaging the pinion 27 with the gear 26 and manipulating the crank 29 in the usual way.

It will be observed that my improved device is very much more compact than the ordinary wooden rigs, will occupy much less space in shipment, can be erected in much less time, and possesses the special advantages due to the improvements in detail already referred to. It will be understood that my improved rig may be employed for pumping wells after the latter have been drilled. Preferably a guide-plate 52 is employed, connecting the legs 3 and bolted also to the braces 5 for keeping the cable on the crown-pulley 4. Since this guide-plate forms a rigid part of the tower, I will claim it in my companion application.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. In a deep-well-drilling apparatus, the combination of a box-like bed or foundation composed of parallel top and bottom members and vertical cross-braces connecting such members, two metallic legs carried by the bed or foundation converging toward each other at their upper ends and leaning slightly over the vertical, two supplemental braces 5, 5, connecting said legs near their tops with the bed or foundation, cross-braces connecting said legs with said supplemental braces, thereby forming a skeleton tower which leans over the vertical, a cross-brace 13 extending across the legs above the bed or foundation, guides 12 secured to said cross-brace 13 and extending vertically upward therefrom, a samson-post supported by the bed or foundation, a walking-beam pivoted to said samson-post with its forward end extending over the cross-brace 13 and working between said guides 12, and means carried by the bed or foundation for operating said samson-post, substantially as and for the purposes set forth.

2. In a deep-well-drilling apparatus, the combination of a box-like bed or foundation composed of parallel top and bottom members and vertical cross-braces connecting such members, two metallic legs carried by the bed or foundation converging toward each other at their upper ends and leaning slightly over the vertical, two supplemental braces 5, 5, connecting said legs near their tops with the bed or foundation, cross-braces connecting said legs with said supplemental braces, thereby forming a skeleton tower which leans over the vertical, a cross-brace 13 extending across the legs above the bed or foundation, guides 12 secured to said cross-brace 13 and extending vertically upward therefrom, a samson-post supported by the bed or foundation, a walking-beam pivoted to said samson-post with its forward end extending over the cross-brace 13 and working between said guides 12, a crank-shaft mounted on the bed or foundation, a crank keyed to said shaft, a

pitman connecting the crank with the rear end of the walking-beam, a gear on the shaft, a counter-shaft mounted on the bed or foundation, a pinion on said counter-shaft driving said gear, a friction-wheel on the counter-shaft, a sand-reel shaft mounted on the bed or foundation and movable toward and away from the said friction-wheel, and a friction-wheel on the sand-reel shaft adapted to be engaged frictionally with the friction-wheel on the counter-shaft, substantially as and for the purposes set forth.

3. In a deep-well-drilling apparatus, the combination of a box-like bed or foundation composed of parallel top and bottom members and vertical cross-braces connecting such members, two metallic legs carried by the bed or foundation converging toward each other at their upper ends and leaning slightly over the vertical, two supplemental braces 5, 5, connecting said legs near their tops with the bed or foundation, cross-braces connecting said legs with said supplemental braces, thereby forming a skeleton tower which leans over the vertical, a cross-brace 13 extending across the legs above the bed or foundation, guides 12 secured to said cross-brace 13 and extending vertically upward therefrom, a samson-post supported by the bed or foundation, a walking-beam pivoted to said samson-post with its forward end extending over the cross-brace 13 and working between said guides 12, means carried by the bed or foundation for operating said samson-post, and a series of braces secured to said legs and extending outside of the tower to form brackets for the support of the piping, &c., substantially as and for the purposes set forth.

This specification signed and witnessed this 27th day of March, 1899.

CHARLES DENIO PIERCE.

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