Feb. 1, 1944. H. W. THORNBURG 2,340,351

PORTABLE DRILL

Filed Nov. 9, 1940 2 Sheets-Sheet 1

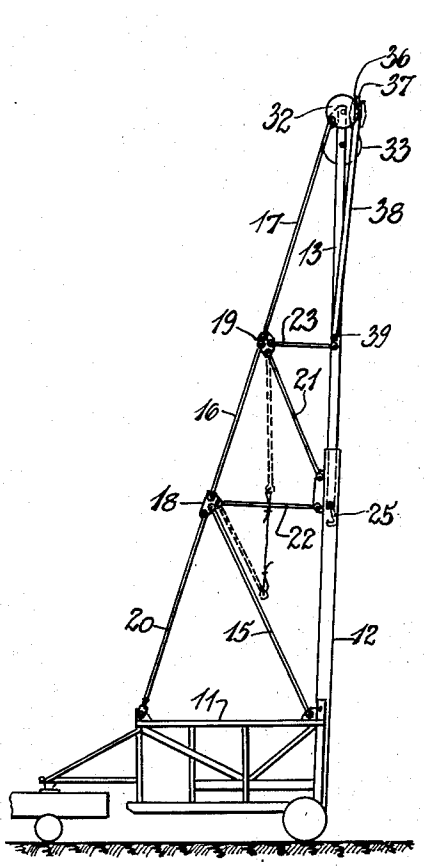


Fig. 1

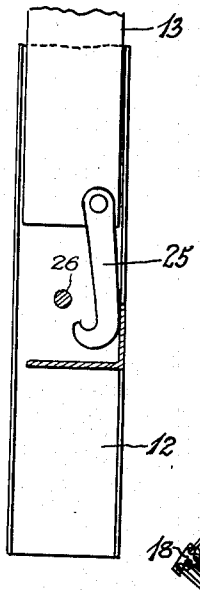


Fig. 5

Fig. 2

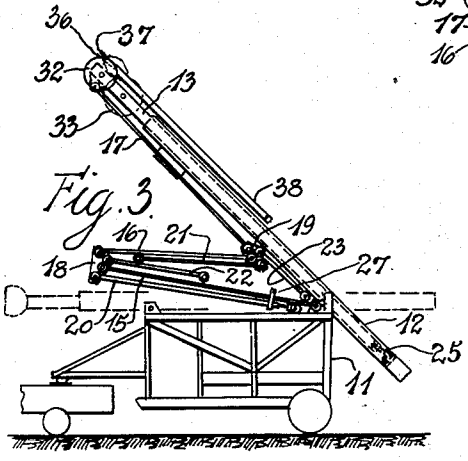


Fig. 3

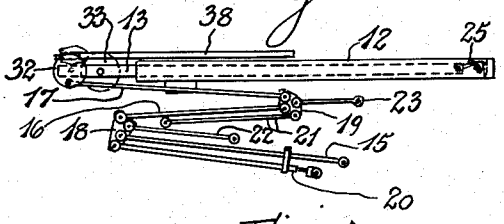


Fig. 4

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Feb. 1, 1944. H. W. THORNBURG 2,340,351

PORTABLE DRILL

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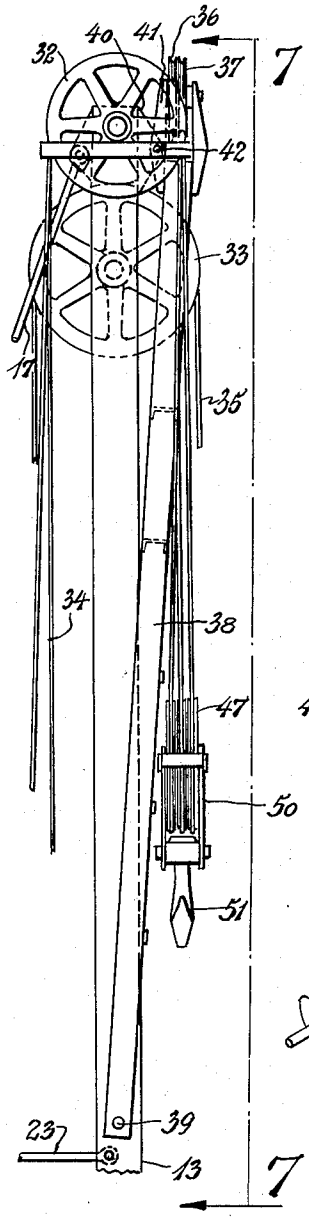


Fig. 6

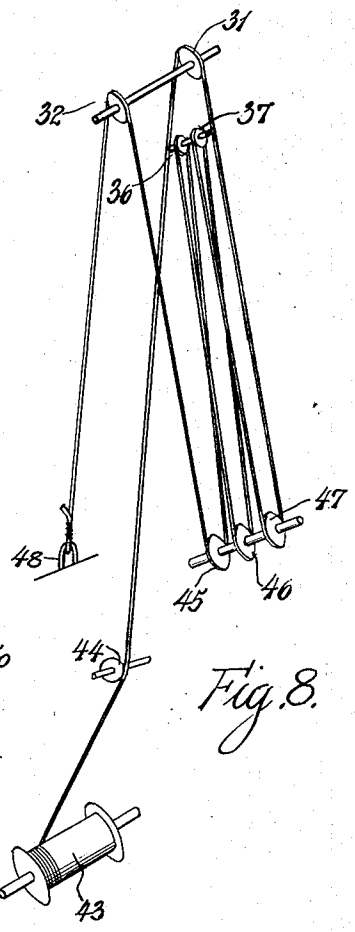


Fig. 8.

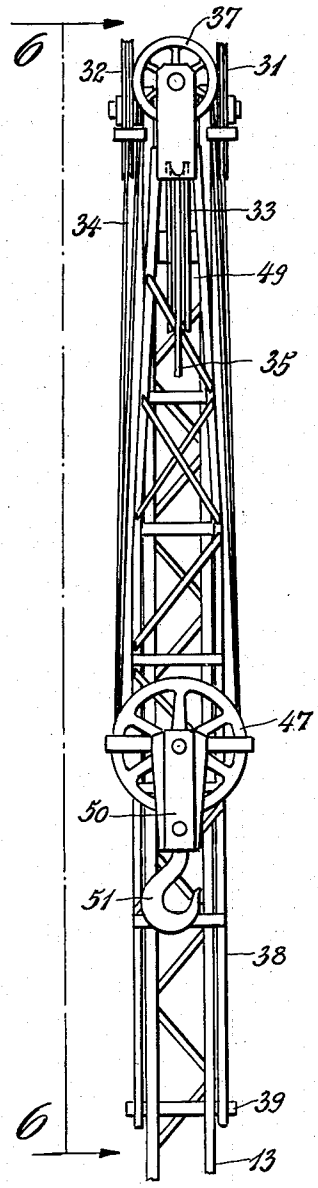


Fig. 7.

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UNITED STATES PATENT OFFICE

2,340,351

PORTABLE DRILL

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Application November 9, 1940, Serial No. 364,993

13 Claims. (Cl. 254—139.1)

My invention relates to new and useful improvements in portable drills.

Heretofore the derrick masts of such drills, the telescopic type of mast in particular, have been supported by detachable braces. In raising the mast to operative position, or in dismantling it, much time and labor have been required to attach (or detach) the braces. Furthermore detachable braces are apt to become mislaid and must be packed or unpacked.

Accordingly it is a principal object of my invention to provide the mast of a drill with a new type of brace construction whereby the hoisting of the mast with its supporting braces can be commenced immediately and accomplished speedily without attachment of any separate members; and whereby, as the mast is lowered into carrying position, the braces fall semi-automatically as a unit into collapsed transport position, without detachment.

A further principal object is to provide an automatic catch for the telescoping mast, which will permit its extension in erect position, and will prevent its extension in all other positions.

In general a drill, such for example as is used for oil-well drilling, has three principal operating tackles with different functions, best described in connection with their respective sheaves at the top of the mast. A single center crown drilling sheave at the top of the mast is for the tool-hoist and drilling line. Casing sheaves above the crown drilling sheave are for the casing line which handles the casing of the drilled hole. A sand sheave, usually below the crown drilling sheave, is used for the bailer line. One feature of my invention relates to the casing tackle and supports thereof.

Normally there are only two sheaves at the top of the mast for the casing line, which is reeved two-line to a single-sheave casing block. But to handle heavy casings a four-part or six-part reeving, with one or two upper auxiliary sheaves respectively, is necessary.

Heretofore there have been two principal methods of supporting these auxiliary sheaves. In the first of these former methods, shear poles, independent of the derrick mast (sometimes even of the whole drill), and held in position by guy lines or other means, have been employed. These shear poles are expensive, clumsy and hazardous, although they have an important advantage, when built to stand astride the derrick mast, in that they permit the casing lines to be centered with respect to the drilling line, without interfering therewith. In the second of these former methods, the auxiliary casing sheaves have been mounted directly on the derrick mast below the drilling line sheave by means of a bracket (or sometimes a chain) attached to the mast. A serious objection to this method of mounting is that, if the horizontal bracket is long enough to achieve centering of the casing line over the casing, there is eccentric loading on the derrick mast. Shortening the bracket throws the casing line out of line, which renders erection of the casing, threading it in particular, very difficult. A further trouble with the second (i. e., bracket) method of suspension is that the auxiliary sheaves, being mounted below the drilling line sheave, will interfere with the drilling line if the auxiliary casing sheaves are so mounted that the casing lines are centered over the casing in line with the drilling line.

Accordingly a further principal object of my invention is to provide a method of mounting the auxiliary casing sheaves which will achieve the advantageous features of each of the above mentioned methods without their accompanying defects, that is, to achieve centering of the casing line, to prevent or reduce to a minimum eccentric loading on the derrick mast, and to mount the casing sheaves clear of the drilling and other operating lines.

In addition to my principal objects, above stated, I have worked out a number of novel and useful details, which will be readily evident as the description progresses.

My invention consists in the novel parts and in the combination and arrangement thereof, which are defined in the appended claims, and of which one embodiment is exemplified in the accompanying drawings, which are hereinafter particularly described and explained.

Throughout the description the same reference number is applied to the same member or to similar members.

Figure 1 is a side elevation of my drill with its mast in upright operative position, the dotted lines indicating certain braces partially dismantled and in position preparatory to telescoping the derrick.

Figure 2 is a side elevation of my drill with its mast in its upright position, but partially telescoped, and with one more brace disassembled.

Figure 3 is a side elevation of my drill with its mast completely telescoped, and partially swung toward horizontal.

Figure 4 is a detail diagram showing the arrangement of the braces in collapsed position.

Figure 5 is a detail showing hook and bar, to lock the two portions of my mast together.

Figure 6 is a detail side elevation of the upper portion of the derrick mast showing the apparatus for handling casing, including strut, sheaves, and block and tackle, taken along the line 6—6 in Figure 7.

Figure 7 is a detail front elevation of the same mast and casing equipment shown in Figure 6, taken along the line 7—7 in Figure 6.

Figure 8 is a diagram of the casing line reeving.

Referring now more particularly to Figures 1 to 4, we see that the main base 11, which contains the drilling machinery, supports at one end the telescoping mast to be hereinafter described. The drill frame 11, the means for its support, and the telescoping mast, are of any conventional design, the details of which do not constitute any part of my invention. In accordance with the usual design, the foot portion 12 of the mast is pivotally mounted at the rear top corner of the frame 11, to permit tilting to a horizontal carrying position on top of the frame, from the substantially vertical extended operative (i. e., erected) position. The mast is, in its preferred form, made up of two rigid telescoping sections, namely the foot 12 and the extensible portion 13.

My mast is braced in its vertical position by my improved construction of collapsible folding braces, of which the construction shown and described herein is merely an illustrative form.

It is a feature of my construction that certain of my braces form a continuous linked chain from a point on my base to a point adjacent the outer end of my mast, and remain permanently attached to these points; while certain other braces, pivotally attached to this chain at all times, are detachably pivoted to my base and my mast at points which are readily accessible, at least at the times when it is necessary to attach or detach them successively.

All of these braces will now be described.

The chain consists preferably of three link braces, 15, 16 and 17, numbered successively from the bottom up.

Lower link brace 15 is pivotally supported by base 11, and is pivotally attached to lower link plate 18. Lower link brace 15 is preferably pivotally attached directly to the base 11 adjacent the pivot at the foot 12 of the mast, rather than to the foot 12. My preference for such direct support is that it enables the bottom of this link brace 15 to be more widely spread than would be possible if the lower end of link brace 15 were attached to the foot 12.

Middle link brace 16 is pivotally attached to lower link plate 18 and to upper link plate 19.

Upper link brace 17 is pivotally attached to upper link plate 19 and to the extensible portion 13 of my mast, preferably to the top thereof.

Lower diagonal brace 20 is pivotally attached to the chain, preferably at lower link plate 18, and is detachably pivotally supported by the base 11, at widely spaced points remote the mast.

Upper diagonal brace 21 is pivotally attached to the chain, preferably at upper link plate 19, and is detachably pivotally supported by the mast, preferably adjacent the upper end of the foot member 12 thereof.

Lower substantially horizontal brace 22 is pivotally attached to the chain, preferably at lower link plate 18, and is detachably pivotally supported by the mast, preferably adjacent the upper end of the foot 12 thereof.

Upper substantially horizontal brace 23 is pivotally attached to the chain, preferably at upper link plate 19, and is detachably pivotally supported by the mast, preferably at some mid point of the extensible portion 13 thereof.

When, in the claims, I describe any element as pivotally supported by a second element, I intend to cover generically supporting the first element either directly or indirectly by the second element.

The detachable pivotal attachments, above referred to, can be of any convenient sort, such as bolts or pins, their exact nature not constituting a part of my invention.

A tension member 24, preferably a rope or chain, or pair of ropes or chains, connects the free ends of lower horizontal brace 22 and upper diagonal brace 21, for a purpose which will be made evident hereinafter.

Although I have stated earlier herein that the details of my telescoping mast do not constitute a part of my invention, nevertheless it is essential to the efficient operation thereof that the means for extending the extensible portion 13 of my mast be such as, when first applied, to tilt my mast from a horizontal position to a substantially vertical (preferably just past vertical) position, and then—holding it thus—to extend the extensible portion. Such means is the tackle shown and described in the copending application of George R. Watson, filed September 16, 1937, Serial No. 164,109, now Patent No. 2,251,309, dated August 5, 1941, for Improvements in multi-use winch-tool for well drills, assigned to my assignee.

But, in connection therewith, I now employ a hook 25, pivoted on the bottom end of the extensible portion 13 of my mast, and engageable with a bar 26 on the bottom end of the foot portion 12 of my mast. The hook is so balanced that when my mast is in its erected position (preferably a little past vertical, as already stated), the hook 25 will automatically hang clear of the bar 26 by gravity, but will automatically engage therewith as my mast tilts back through vertical toward horizontal.

To lower my mast, from its erected position as shown in Figure 1, the operator first mounts to the top of the foot portion 12, as by a ladder (not shown) built thereon, and detaches the adjacent ends of upper diagonal brace 21 and lower horizontal brace 22, which then hang free, interconnected by tension member 24, as shown dotted in Figure 1.

The lower end of the lower diagonal brace 20 is then detached from the base, and is swung toward the mast, and is lashed to lower link brace 15 in any convenient manner, as by lashings 27. This step could be performed prior to the first-mentioned step, if desired.

The extensible portion 13 of my mast is then lowered until the point of attachment of upper horizontal brace 23 is within easy reach of the operator, still perched near the top of the foot portion 12, as shown in Figure 2. He then unhitches this attachment. The lower end of the supporting strut 38 for the auxiliary casing line sheaves, to be later described herein, is also detached at this time.

The extensible portion 13 of the mast can then be completely lowered.

With further paying out of the raising tackle, the weight of the braces, having a long torque-arm by virtue of being held off from the mast by lower link brace 15, tips the mast over as shown in Figure 3.

As this tipping starts, hook 25 automatically swings by gravity into engagement with bar 26. This is very important, as otherwise, in the position shown in Figure 3, the tension in the raising tackle would cause the extensible portion 13 of the mast to shoot out.

As the mast, telescoped and hooked together, swings down toward horizontal, the upper diagonal brace 21 may have to be guided away from the mast by hand, and upper horizontal brace 23 may have to be guided toward the mast by hand,

so that the braces will all lie in the position shown in Figure 4; but the tension member 24 should guide braces 21 and 22 into their proper positions.

Raising is an even more simple operation. Drawing in on the raising tackle tilts the mast, telescoped and hooked together to its past vertical position, whereupon hook 25 automatically falls free of bar 26.

Further pull on the tackle extends the extensible portion 13 to the position of Figure 2, whereupon the operator can attach upper horizontal brace 23, as there shown.

Still further pull on the tackle extends the extensible portion 13 to the position of Figure 1, whereupon braces 20, 21 and 22, and supporting strut 38, can be attached as there shown, thus completing erection.

Referring now to Figures 6 to 8, we see that the casing tackle equipment is arranged and mounted on the extensible portion 13 of my mast as follows. At the top of the mast we have casing line sheaves 31 and 32, and "crown" drilling line sheave 33 thereunder. The casing line sheaves 31 and 32 are of radius sufficient to locate the casing line 34 over the casing, parallel with the drilling line 35, and at a working distance from the mast. Above the drilling line sheave 33, and preferably above or level with the casing line sheaves 31 and 32, and lying in vertical planes perpendicular to the planes of the casing line sheaves 31 and 32 near the forward edges thereof (to maintain the casing line parallel with the drilling line) are the auxiliary casing line sheave or sheaves 36, 37, which are mounted on the supporting strut 38. The base of this strut is bolted, or otherwise secured, preferably detachably, to the lower portion of the upper extensible part 13 of the mast at a braced point 39 thereof, preferably at or near the upper horizontal brace 23, which thus takes the horizontal component of the load on said strut. The top of the strut is rigidly attached at the top of the mast by suitable means, such as a brace, or, as in my embodiment, a pin connection 42 between two overlapping ears 40 and 41 extending from the mast and strut respectively. It is to be noted that, inasmuch as this attachment is adjacent to the point of attachment of upper link brace 17 to the mast, this brace takes a part of the load on said strut. The described location of the points of attachment of the strut to the mast is important, as relieving the mast of bending strains, which the strut would otherwise impose.

Referring now to Figure 8, let us examine the casing line reeving. This figure shows a six-line reeving, but it should be understood that my invention is not limited thereto. Casing line 34 passes from a conventional powered "calf" reel (no part of my invention) on the main drill frame 11 and diagrammatically indicated at 43 only, under deflecting sheave 44 on the drill frame, up over the right-hand casing sheave 31 at the top of the mast, twice down through the forward sheaves 47, 46 of the casing block 50 (shown with a conventional hook 51), twice back up over the auxiliary casing line sheaves 37, 36, then down through the rear sheave 45 of the casing block 50 and up over the left-hand casing sheave 32 on the top of the mast, and thence to an anchorage 48 on the drill frame. The purpose of passing the casing line over the dead casing sheave 32 to a dead end on the drill frame 11 is to achieve a balanced loading on the derrick mast, but such a method of reeving is not necessary, although it is preferable. Any other suitable reeving utilizing my strut-supported auxiliary casing sheaves may be adopted.

Referring now again to Figures 6 and 7, let us examine the function of the various parts in the light of my objects. First we see that the auxiliary casing line sheaves 36 and 37 are so mounted relative to the drilling line sheave 33 that the casing line which passes through them falls to the casing approximately centered and parallel to the drilling line 35. Secondly we see that, in spite of this alignment and centering, eccentric loading on the derrick mast is minimized and directly disposed of through the strut 38 to the upper horizontal brace 23 and the vertical mast at 39, and through the connected ears 40 and 41 to the upper link brace 17 at the top of the mast, as already stated. Thirdly we see that the auxiliary casing line sheaves 36, 37 do not interfere with the drilling line crown sheave 33, in spite of the above mentioned alignment, because they are placed above said crown sheave; and that the strut 38 itself does not interfere with the crown sheave 33 or the drilling line 35 which passes through the sheave, because of the slot or opening 49 in the strut 38, through which the crown sheave 33 protrudes and the drilling line 35 passes.

Having now described and illustrated one form of my invention, I wish it to be understood that my invention is not to be limited to the specific form or arrangement of parts herein described and shown, except as specifically covered by my claims.

I claim:

1. In a drill, the combination of: a base; a foot portion of a mast, pivoted on the base for tilting from a substantially horizontal position to a substantially vertical position; an extensible portion of the mast, extensible upwardly longitudinally along the foot portion; a jointed chain of three link braces, extending from a pivotal support on the base adjacent the pivot of the foot portion of the mast to a pivotal connection with the mast adjacent its upper end; a lower diagonal brace, pivotally attached to the chain adjacent the chain's lower joint, and detachably pivotally supported by the base distant from the pivot of the foot portion of the mast; a lower substantially horizontal brace, pivotally attached to the chain adjacent the chain's lower joint, and detachably pivotally supported by the foot portion of the mast adjacent its upper end; an upper diagonal brace, pivotally attached to the chain adjacent the chain's upper joint, and detachably pivotally supported by the foot portion of the mast adjacent its upper end; and an upper substantially horizontal brace, pivotally attached to the chain adjacent the chain's upper joint, and detachably pivoted on the extensible portion of the mast intermediate its ends.

2. A drill, according to claim 1, characterized further by having a tension element connecting the lower horizontal brace and the upper diagonal brace adjacent their detachable ends.

3. In a drill, the combination of: a base, a foot portion of a mast, pivoted on the base for tilting from a substantially horizontal position to a substantially vertical position; an extensible portion of the mast, extensible upwardly longitudinally along the foot portion; a jointed chain of link braces, extending from a pivotal connection with the base to a pivotal connection with the mast adjacent its upper end; a lower diagonal brace, pivotally attached to the chain ad-

jacent the chain's lower joint, and detachably pivotally supported by the base; a lower substantially horizontal brace, pivotally attached to the chain adjacent the chain's lower joint, and detachably pivotally supported by the mast adjacent the upper end of the foot portion thereof; an upper diagonal brace, pivotally attached to the chain adjacent an upper joint of the chain, and detachably pivotally supported by the mast; and an upper substantially horizontal brace, pivotally attached to the chain adjacent an upper joint of the chain, and detachably pivoted on the mast intermediate its ends.

4. A drill, according to claim 3, characterized further by having a tension element connecting the lower horizontal brace and the upper diagonal brace adjacent their detachable ends.

5. In a drill, the combination of: a base; a foot portion of a mast, pivoted on the base for tilting from a substantially horizontal position to a substantially vertical position; an extensible portion of the mast, extensible upwardly longitudinally along the foot portion of the mast; a jointed chain of link braces, extending from a pivotal connection with the base to a pivotal connection with the mast; diagonal braces, each pivotally attached to the chain adjacent one of the chain's joints, at least one thereof being detachably pivotally attached to the mast; and substantially horizontal braces, each pivotally attached to the chain adjacent one of its joints, and each pivotally attached to the mast, at least one thereof being detachably so attached.

6. In a drill, the combination of: a base; a foot portion of a mast, pivoted on the base for tilting from a substantially horizontal position to a substantially vertical position; an extensible portion of the mast, extensible upwardly longitudinally along the foot portion of the mast; a jointed chain of link braces, extending from a pivotal connection with the base to a pivotal connection with the mast; diagonal braces, each pivotally attached to the chain, at least one thereof being detachably pivotally attached to the mast; and substantially horizontal braces, each pivotally attached to the chain, and each pivotally attached to the mast, at least one thereof being detachably so attached.

7. A drill, according to claim 1, in which the mast is adapted to pivot from a substantially horizontal position to a substantially vertical position, and having: automatic catch means, consisting of two engageable members, one being on each portion of the mast, whereby the two portions of the mast are automatically locked against extension in all positions except the substantially vertical position, in which position they are automatically unlocked.

8. A drill, according to claim 3, in which the mast is adapted to pivot from a substantially horizontal position to a substantially vertical position, and having: automatic catch means, consisting of two engageable members, one being on each portion of the mast, whereby the two portions of the mast are automatically locked against extension in all positions except the substantially vertical position, in which position they are automatically unlocked.

9. In a drill, the combination of: a base, a foot portion of a mast, pivoted on the base for tilting from a substantially horizontal position to a substantially vertical position; an extensible portion of the mast, extensible upwardly longitudinally along the foot portion of the mast; and automatic catch means, consisting of two engageable members, one being on each portion of the mast, whereby the two portions of the mast are automatically locked against extension in all positions except the substantially vertical position, in which position they are automatically unlocked.

10. A drill, according to claim 9, wherein the catch means consists of: an engagement carried by the foot portion of the mast; and a hook hanging pivotally from the extensible portion of the mast, and biased to engage the engagement in all positions of the mast except its substantially vertical position, and to swing clear of the engagement whenever the mast is in its substantially vertical position.

11. In a drill, which includes: a base; a substantially vertical mast thereon; slant bracing means, supporting the mast by extending from the base to the mast at a point adjacent the top of the mast; a substantially horizontal brace, extending from said bracing means to the mast at a point below the top of the mast; and a drilling sheave, supported by the mast adjacent its top: in combination therewith, the following: two parallel casing hoist sheaves adjacent the top of the mast, one being on each side of the mast; an inclined strut, supported by the mast, adjacent the point of attachment of the horizontal brace; a support for the upper end of the strut, supported by the mast adjacent the point of attachment of the slant brace; and at least one sheave, pivoted on the strut above the level of the drilling sheave adjacent the upper end of the strut, and lying in a plane perpendicular to the plane of the casing hoist sheaves.

12. In a drill, which includes: a base; a substantially vertical mast thereon; slant bracing means, supporting the mast by extending from the base to the mast at a point adjacent the top of the mast; a substantially horizontal brace, extending from said bracing means to the mast at a point below the top of the mast; and a drilling sheave, supported by the mast adjacent its top: in combination therewith, the following: two parallel casing hoist sheaves adjacent the top of the mast, one being on each side of the mast; an inclined strut, supported by the mast, adjacent the point of attachment of the horizontal brace; a support for the upper end of the strut, supported by the mast adjacent the point of attachment of the slant brace; and at least one sheave, pivoted on the strut adjacent its upper end, and lying in a plane perpendicular to the plane of the casing hoist sheaves.

13. In a drill, which includes: a base; a substantially vertical mass thereon; slant bracing means, supporting the mast by extending from the base to the mast at a point adjacent the top of the mast; and a drilling sheave, supported by the mast adjacent its top, in combination therewith, the following: substantially coaxial laterally spaced casing hoist sheaves supported by the mast adjacent its top; an inclined strut, supported by the mast at a point substantially below the top of the mast; a support for the upper end of the strut, supported by the mast adjacent the point of attachment of the slant brace; at least one casing hoist sheave, pivoted on the strut adjacent its upper end, and lying in a plane perpendicular to the plane of the casing hoist sheaves; and a casing hoist line trained over the casing hoist sheaves.

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