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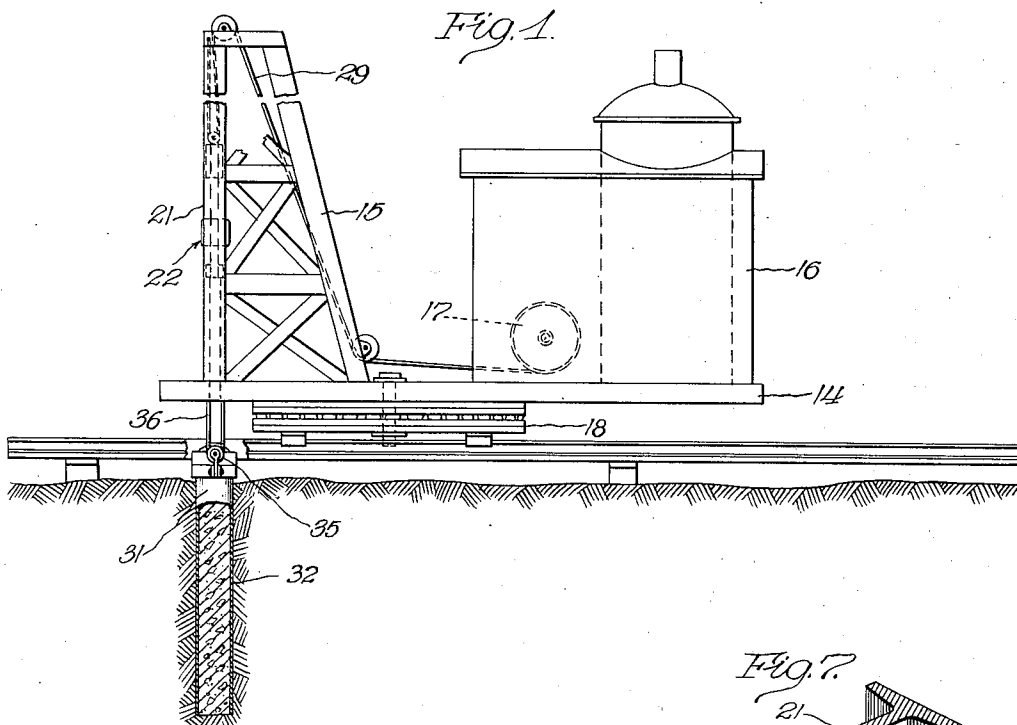
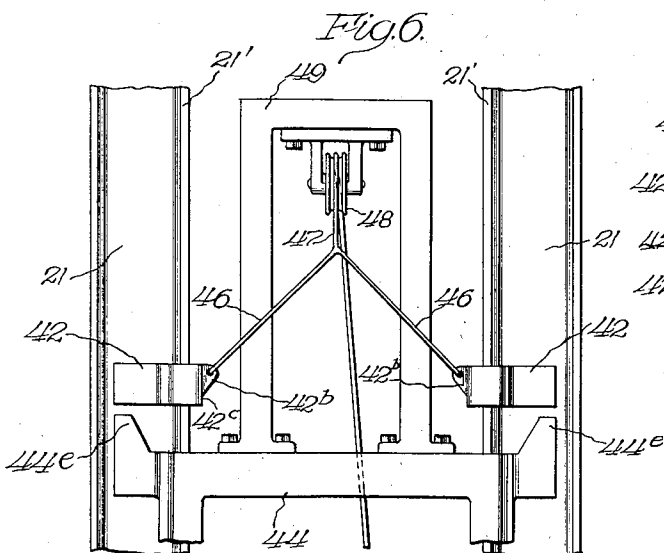
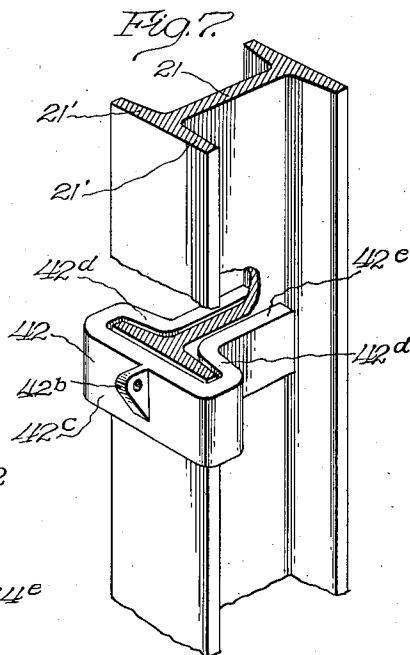
J. H. THORNLEY

2,019,548

PILE DRIVER

Filed June 22, 1931

3 Sheets-Sheet 1



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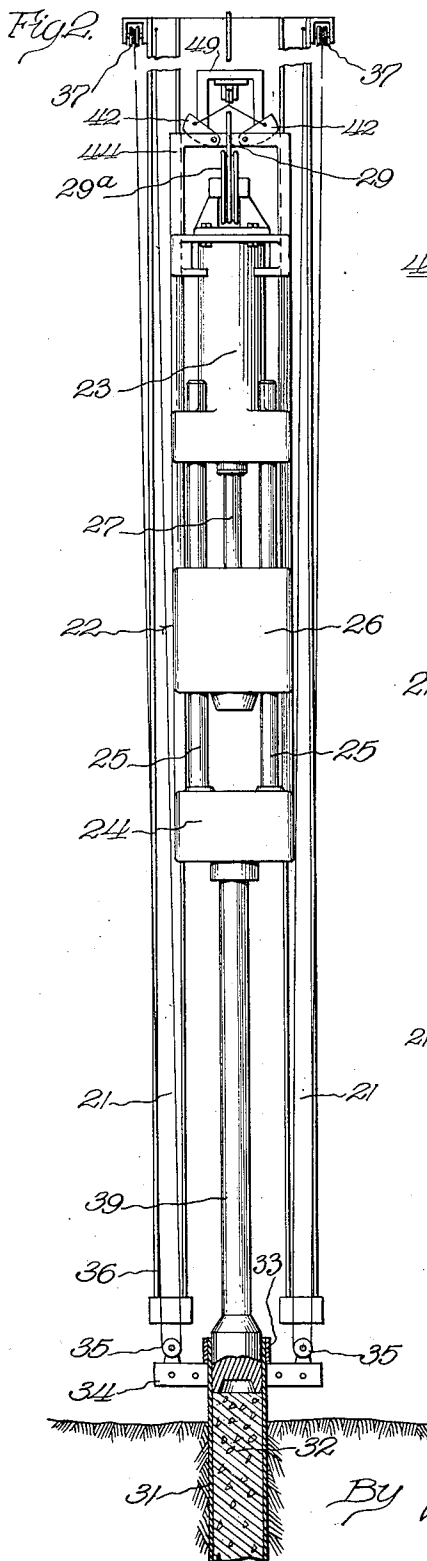
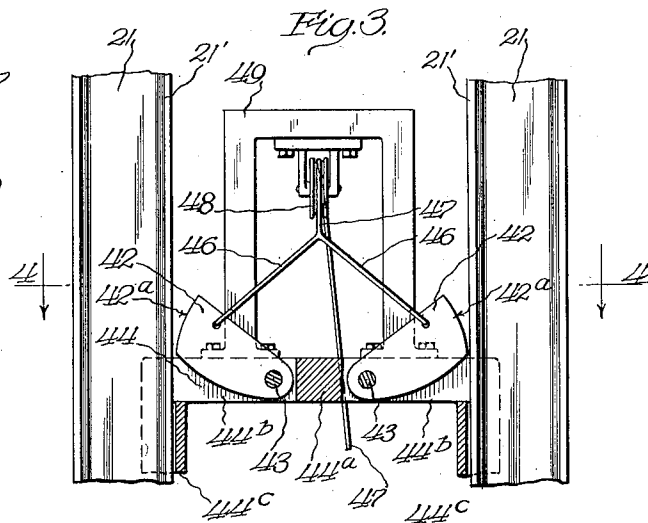
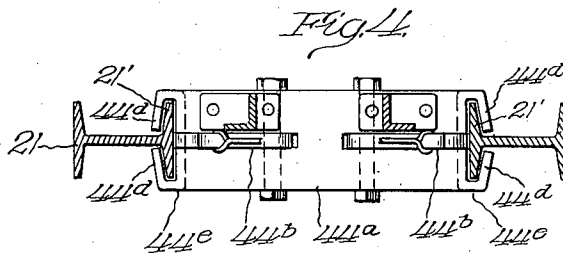
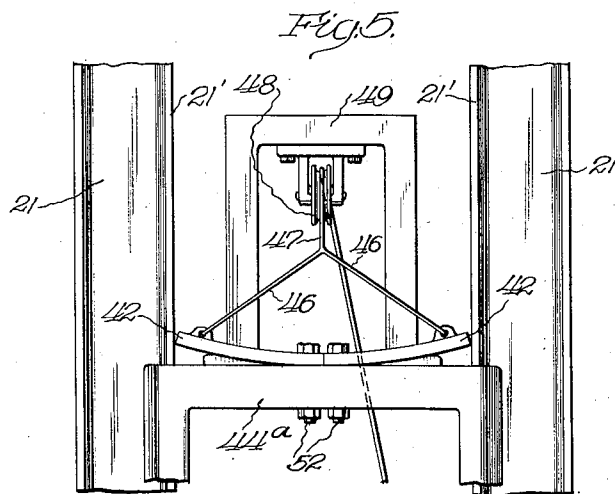
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PILE DRIVER

Filed June 22, 1931

3 Sheets-Sheet 2



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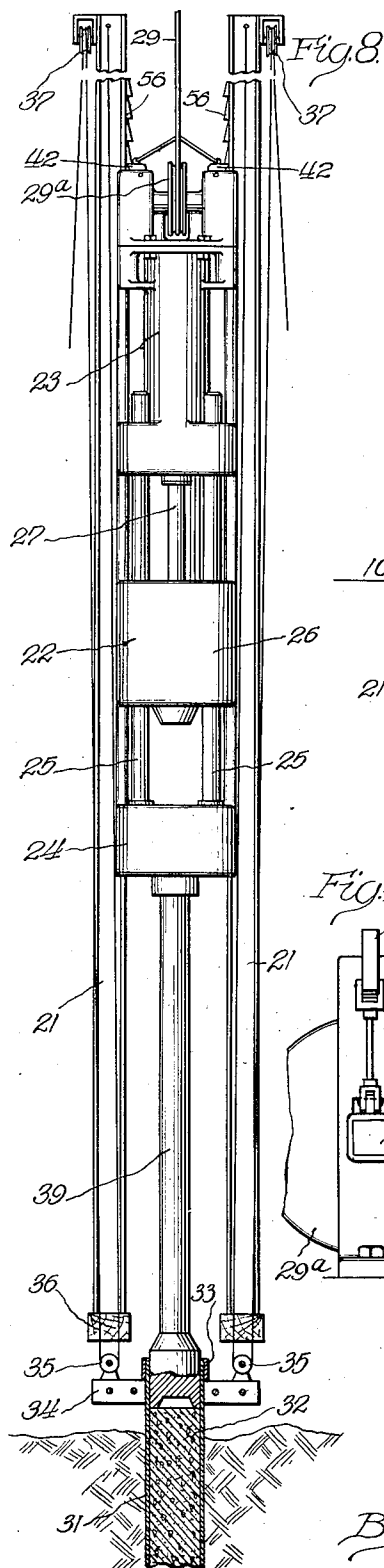
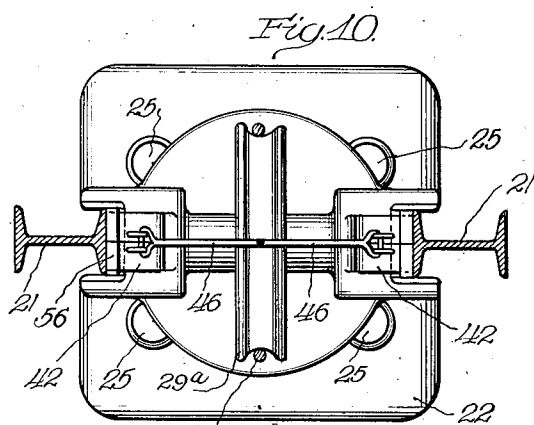
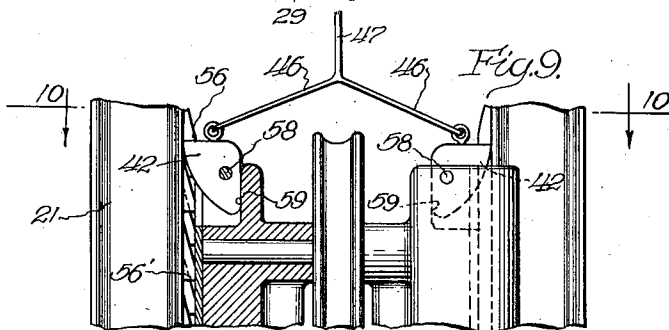
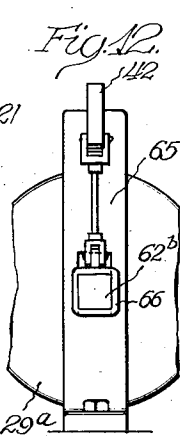
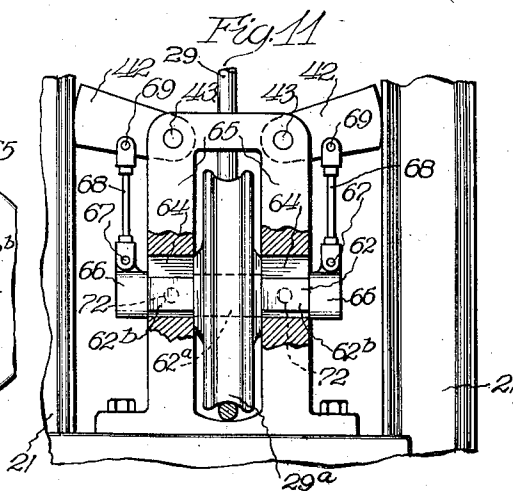
J. H. THORNLEY

2,019,548

PILE DRIVER

Filed June 22, 1931

3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

2,019,548

## PILE DRIVER

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Application June 22, 1931, Serial No. 546,003

13 Claims. (Cl. 61—74)

The present invention relates to pile drivers, and embodies improvements particularly adapted to the performance of certain hoisting operations.

upward movement while permitting downward movement thereof.

A further object is to provide improved means for controlling the releasing and engaging of said locking mechanism. In one preferred embodiment the releasing and engaging of the locking mechanism is effected by the winding in and slacking off of the tackle line which raises and lowers the hammer unit.

Referring to the accompanying drawings illustrating preferred embodiments of my invention:

Figure 1 is a fragmentary side elevational view of a pile driver embodying my invention and engaged in the operation of hoisting a form casing;

Figure 2 is a front elevational view of the hammer leads, showing the hammer unit therein and illustrating one form of my invention on the hammer unit;

Figure 3 is a vertical sectional view through the upper portion of the hammer unit showing this form of my invention;

Figure 4 is a transverse sectional view taken approximately on the plane of the line 4—4 of Figure 3;

Figure 5 is an elevational view, similar to Figure 3, and showing another form of my invention;

Figure 6 is a view similar to Figure 5 and showing another form of my invention;

Figure 7 is a perspective view with portions broken away in section, illustrating the embodiment shown in Figure 6;

Figure 8 is a view generally similar to Figure 2, illustrating the location and arrangement of another form of my invention on the hammer unit;

Figure 9 is a detail view, partly in section, showing this latter form in a larger scale;

Figure 10 is a transverse sectional view taken approximately on the plane of the line 10—10 of Figure 9;

Figure 11 is a view similar to Figure 3, showing a modified arrangement wherein the engaging and releasing of the locking mechanism is controlled through the hammer hoisting line; and

Figure 12 is a fragmentary side view of the latter construction.

The general structure of the pile driver may be of any conventional type comprising a platform 14, a derrick 15 rising from one end thereof, and a power plant 16 mounted on the other end of the platform, such power plant comprising any usual arrangement of winding drums 17. The platform 14 may be either rotatably or non-ro-

In the construction of cast-in-place concrete piles, the general practice is to sink a core and casing down into the ground to the desired depth, then to withdraw the core, leaving the casing in the ground as a form, then to fill the casing with concrete, and then to withdraw the casing from around the column of concrete before the latter has set. Difficulties frequently arise in this last step of withdrawing the form casing. Obviously, no material portion of the concrete column should be permitted to move upwardly with the casing, otherwise the sectional thickness of the column may be materially reduced with consequent loss of strength in both compression and tension, or a complete break may occur in the continuity of the column, allowing the earth walls to close into the space. This arises quite often, however, as for instance because of a cluster of stones in heavy aggregate bunching together and forming an arch wedging between the side walls of the upwardly moving casing and lifting the superposed concrete with it, or because of any other condition wherein the concrete becomes wedged or bound in the casing and tends to move upwardly with it. The placing of a weighted core on the upper end of the concrete column is not adequate because this core can be lifted upwardly by the above described condition or by small stones becoming wedged between the side walls of the casing and the end of the core. Moreover, it is desirable that the concrete column be pressed downwardly simultaneously with the lifting of the casing so that the concrete will be caused to spread out below the casing into the space formerly occupied by the casing wall; also, that as the concrete column recedes downwardly, consequent upon spreading out into the space formerly occupied by the casing wall, this pressure be made to follow up the receding column so that it is effective thereon until the casing is completely withdrawn.

It is the general object of my invention to provide an improved method and apparatus in association with pile drivers whereby these prior objections are overcome and the desired improved method of operation and result are obtained.

Another object of my invention is to provide an improved construction and arrangement of locking mechanism, preferably comprising locking dogs, for holding the hammer unit against

tatably mounted upon a bed 18. The front side of the derrick structure 15 comprises the usual spaced hammer leads or guides 21 between which the pile driving hammer unit 22 is adapted to slide vertically. The hammer unit may be of any desired construction, the one shown comprising an upper steam cylinder 23, a lower hammer base 24 which is connected to the cylinder 23 by vertical guide rods 25, and a ram 26 which reciprocates along these guide rods and is connected to the piston rod 27 extending from the cylinder 23. A tackle line 29 has connection with the upper end of the hammer unit for raising and lowering the latter.

Figure 2 illustrates the pile driver performing the operation of pulling a form casing 31 upwardly from around a cast-in-place concrete pile 32. A collar 33 rigidly secured to the upper end of the casing 31 forms a shoulder under which a hoisting yoke 34 is engaged. Sheave blocks 35 on the outer ends of said yoke have hoisting lines 36 reeved around the sheaves and extending up to sheave blocks 37 mounted at the upper portions of the hammer leads 21. These lines are adapted to be extended to the winding means 17 for exerting a hoisting pressure on the casing 31.

During the hoisting of the casing a continuous downward pressure is exerted on the concrete column 32 by placing a core or follower 39 in the upper end of the casing to bear on the concrete, and imposing the weight of the hammer unit 22 on the upper end of this core. My invention resides principally in the provision of improved means whereby the hammer unit is positively locked in the hammer leads 21 against upward movement, and whereby the hammer unit is always free to move downwardly so that as the top of the concrete column 32 moves downwardly with the outward spreading of the concrete into the space below the casing 31 the hammer unit will move downwardly and maintain its continuous pressure on the concrete.

Figures 2, 3 and 4 illustrate one form of this improved mechanism. It comprises two locking dogs 42 which are pivotally mounted at 43 and are adapted to have locking engagement against the inner sides of the hammer leads 21. The pivotal mounting of said dogs may be effected in various ways, either directly upon any suitable part of the conventional hammer unit 22, or upon a fitting or attachment bracket which is secured to the latter arrangement, wherein the dogs are pivotally mounted on the upper cross bar portion of an inverted U-shaped bracket 44 which is secured to the head end of the hammer unit. Where a sheave block 29a is provided on the upper end of the hammer unit for the hammer hoisting line 29, this attachment bracket 44 may be disposed to extend across the upper side of said sheave block, as shown in Figure 2. The dogs are mounted in transverse slots 44b provided in the top cross bar portion 44a of the bracket. The side legs 44c of said bracket have confining flanges 44d which extend around on the outer sides of the inner flanges of the adjacent I-beam hammer lead 21.

The outer gripping surfaces 42a of the dogs are curved eccentrically relative to their pivot axes 43 so that when these dogs are in engagement with the inner sides of the hammer leads 21 any upward pressure acting on the hammer unit causes said dogs to bind with a wedging grip against the hammer leads. Hence, it is impossible for hoisting pressure transmitted from the concrete

column 32 through the core 39 to the hammer unit to raise the hammer unit. However, as the concrete column moves downwardly concurrently with the hoisting of the casing 31 the hammer unit 22 can also move downwardly, the dogs 42 swinging upwardly slightly to permit this, but in each successively lowered position the dogs are effective to positively lock the hammer unit against upward movement. It will be noted that the outward pressure exerted by the dogs against the hammer leads in their gripping function is precluded from spreading the leads outwardly by virtue of the confining flanges 44d which embrace the outer sides of the inner flanges 21' of each hammer lead.

When it is desired to release the dogs to enable the hammer unit to be lifted to the top of the derrick upon the completion of a hoisting operation, the two dogs are pulled upwardly and inwardly to positions clear of the hammer leads through cable or link connections 46 having attachment to both dogs. These connections 46 are connected to a releasing cable 47 which passes over a sheave 48 mounted above the dogs. Snubbing the lower end of the cable 47 around one of the winding drums 17 enables sufficient pressure to be exerted through the cable to release the dogs. The sheave 48 is mounted in an inverted U-shaped frame 49 which may be a continuation of the frame 44, or may be a separate frame bracket bolted thereto. As the hammer unit is being hoisted to the upper ends of the leads sufficient tension is maintained on the cable 47 to hold the dogs 42 in their retracted positions.

The modified form illustrated in Figure 5 is generally similar to that described above except that the two dogs 42 consist of heavy plates or bars which are adapted to be sprung downwardly into a wedging grip with the hammer leads. In the preferred construction of this embodiment the dogs consist of two plates having their inner ends abutting and securely fastened to the top of the cross member 44a of bracket 44 by bolts 52. The length of the two plates is slightly greater than the space between the hammer leads, and when the outer ends of said plates are allowed to spring downwardly and grip the hammer leads any upward pressure on the hammer serves to force the plates into a tighter wedging grip with the inner sides of the leads, thereby locking the hammer unit against upward movement but at the same time permitting the hammer unit to descend as the top of the concrete column 32 lowers with continued hoisting of the casing. The dogs are released by the same arrangement of connecting cables or links 46 secured to one end of a releasing cable 47 passing over an upper sheave 48. The inward pressure exerted against the ends of the dogs when gripping the leads is borne by the inner ends of the plates abutting each other. As an alternative construction, the two dogs may consist of a single plate having its central portion secured to the bracket member 44 as indicated; or in the two-plate construction shown the inner ends of the plates may have slight pivotal movement on the shanks of the bolts 52. The outward pressure exerted by said dogs against the hammer leads is also borne in this embodiment by the confining flanges 44d embracing the outer sides of the inner lead flanges 21'.

Figures 6 and 7 illustrate a modified form wherein the locking grip of the dogs is effective against the inner and outer sides of the lead flanges 21'. In this form each dog consists of a heavy plate member comprising an inner portion

42c extending across the inner surfaces of the flanges 21', outer portions 42d which bend inwardly and embrace the outer sides of the flanges 21', and outwardly projecting actuating legs 42e which extend crosswise of and parallel with the web of the hammer lead on each side thereof. The portions 42c and 42d are so proportioned that the dog is free to slide along the lead when no cocking pressure is exerted against the leg portions 42e, but as soon as an upward pressure is exerted against the outer ends of these leg portions the cocking of the dog members causes them to firmly grip the inner and outer sides of the flanges 21'. These dogs are disposed to slide on the hammer leads above the bracket 44. The latter has arms 44e which lie under the legs 42e of the dogs. Preferably, the arms 44e are arranged in pairs, disposed one in front and one in back of the web portion of each lead rail, although only one such arm might be provided to engage one leg 42e on each dog.

It will be evident that upward pressure exerted on the hammer unit will act through the arms 44e to rock the dogs into a cocked gripping relation where they will bind against the inner and outer sides of the flanges 21' and securely lock the hammer unit against upward movement. As the hammer unit moves downwardly progressively with the lowering of the concrete column 32 the dogs 42 will also move downwardly therewith, and in each position will be effective to lock the hammer unit against upward movement. Eyes 42b extending from the dogs are adapted to have the releasing connections 46 attached thereto and connected in turn to the releasing cable 47 passing over the upper sheave 48. Tension exerted through these releasing connections enables the dogs 42 to slide freely up along the hammer leads so that the hammer unit can be raised to the top of the derrick. It will be noted that this latter embodiment has no tendency to spread the hammer leads apart in their gripping action, but that the gripping action is confined entirely to opposite surfaces on each lead rail.

In Figures 8, 9 and 10 I have illustrated a form in which the dogs consist of pawls which engage ratchet teeth in vertical rack bars 56 extending along the guide leads 21. Said rack bars are rigidly secured to the guide leads and may extend from top to bottom thereof or may extend over only a limited part of the lengths of the guide leads where the hammer would be reposing in the ordinary hoisting operation. The transverse width of the rack bars may be made narrower than the transverse width of the inner face of each guide lead, thereby leaving guide areas along each side of the rack bars for contact with cooperating guide members on the hammer unit. The ratchet teeth 56' of the rack bars are preferably square cut at right angles to the line of the leads so that the locking pressure is substantially entirely vertical and does not tend to spread the leads. Where it is desired that the ratchet locking occur at closely spaced points two sets of ratchet teeth 56' may be provided on each guide lead 21, with the teeth being staggered or offset vertically as clearly shown in Figure 9. In such arrangement two locking pawls would be disposed side by side, one for engaging one series of teeth and the other for engaging in the other teeth. The dogs or pawls 42 are pivotally mounted on transverse pins 58, and have tail portions which are adapted to engage abutment shoulders 59 for limiting the outward swinging movement of the pawls. When the dogs are to be held noneffective

they may be swung back and held in released positions in any suitable or preferred manner; or releasing connections 46 may have attachment thereto substantially as described of the preceding embodiments. The dogs 42 may be mounted directly on any portion of the hammer unit 22, or they may be mounted in a bracket member 44 secured to the upper end of the hammer unit, as described, for example, in connection with the devices of Figure 3 of the drawings.

In Figures 11 and 12 I have illustrated a modified construction wherein the releasing and engaging of the locking dogs is effected through the hammer hoisting line 29. The hoisting line sheave 29a is movably mounted on the hammer unit 22 for vertical relative movement and this relative movement controls the locking dogs. The hammer line 29 passes down from the head block at the top of the derrick and is reeved around the sheave 29a and then passes up to a dead-ending point at the top of the derrick. The other end of this tackle line extends down to the winding drums 17 of the power plant, and by winding in and slacking off on this line the hammer unit is raised and lowered. The sheave 29a is rotatably mounted on the cylindrical central portion 62a of a transverse journal pin 62. The end portions of said pin are square or have flat sides, as indicated at 62b, and these polygonal end portions are mounted for vertical sliding motion in slots 64 formed in the two side arms 65 of a supporting yoke extending upwardly from the cylinder end of the hammer unit.

Secured to the outer extremities of the pin ends 62b are collars 66 to which the lower ends of links 68 are pivoted at 67. The upper ends of said links are pivotally connected to the dogs 42 at pivot points 69 spaced outwardly from the pivot axes 43 of the dogs.

It will be evident that an upward pull exerted through the hammer line 29 will pull the sheave 29a upwardly by virtue of the slots 64 and this relative motion will act through the links 68 to release the locking dogs 42. With the ends of the journal pin 62 bearing against the tops of the slots 64, the continued upward pull on the hammer line will raise the hammer unit in the derrick leads, with the locking dogs 42 meanwhile held in their released positions. As soon as the line 29 is slacked off, and assuming that the hammer unit is resting on a core or follower 39 as is true in the present casing stripping operation above described, the sheave 29a drops down and thereupon the locking dogs 42 swing down into position to grip the leads 21 of the tower. The locking dogs thereafter function in the same manner first described, to hold the hammer unit against upward movement while still permitting downward movement thereof.

If desired, holes 72 may be provided through the yoke arms 65 in position to receive suitable bolts or pins below the square ends 62b of the journal shaft when the latter is in its uppermost position, whereby to fixedly hold the dogs 42 in their released positions when it is desired freely to raise and lower the hammer unit without interference by the dogs. If multiple reeving of the hammer line 29a is desired for compounding this tackle connection, two or more sheaves can be mounted side by side on the cylindrical portion 62a of the journal shaft 62.

This same method of automatically releasing and engaging the detent dogs through the hammer line 29 can be embodied in the modifications of Figures 5 to 9, inclusive, by extending the links

68 up to appropriate points on these modified forms of dogs, whereby the same releasing and engaging operation will occur.

While I have shown what I regard to be the preferred manner of practicing my invention it will be understood that such is merely exemplary and that other practices and constructions may be adopted within the broader aspects of my invention.

I claim:

1. In a pile driver, the combination of hammer leads, a hammer guided therein, a hammer hoisting line, a sheave on the hammer for said line, a support for said sheave movably mounted on said hammer for limited vertical movement relative thereto, locking means allowing said hammer to descend in said leads but preventing the hammer from being moved upwardly therein due to upward thrust against the lower end of the hammer, and means connecting said movable sheave support with said locking means whereby said locking means can be released by upward pull transmitted through said hoisting line.

2. In a pile driver, the combination of hammer leads comprising smooth plane surfaces, a hammer unit guided therein, a tackle connection for raising and lowering said hammer in said leads, means disposed within the plane of said leads and cooperating with the smooth plane surfaces thereof for allowing said hammer unit to descend in said leads but preventing upward movement therein due to upward thrust against said hammer unit, and means operable through said tackle connection for releasing said last named means.

3. In a pile driver, the combination of hammer leads comprising oppositely disposed smooth plane surfaces, a hammer unit guided therein, a tackle connection for raising and lowering said hammer within said leads, cam means disposed within the plane of said leads and adapted to have wedging locking engagement with the oppositely disposed smooth plane surfaces thereof for preventing upward movement of said hammer unit but allowing said hammer unit to descend in said leads, and means operable through said tackle connection for releasing said last-named means.

4. In a pile driver, the combination of hammer leads comprising oppositely disposed smooth plane surfaces, a hammer unit guided therein, cam means disposed within the plane of said leads and adapted to have wedging locking engagement with the oppositely disposed smooth plane surfaces thereof for preventing upward movement of said hammer unit but allowing said hammer unit to descend in said leads, said wedging action of said cams tending to force said leads apart, means carried by said hammer unit for preventing lateral spreading of said leads under the action of said cam means, and means responsive to upward pull on said hammer for releasing said cam means.

5. In a pile driver, the combination of hammer leads and flanges on said hammer leads, a hammer unit guided in said hammer leads, holding means allowing said hammer unit to descend in said leads but preventing upward movement therein, means carried by said hammer unit and embracing said flanges for preventing lateral spreading of said leads under the action of said holding means, and means responsive to an upward pull on said hammer for releasing said holding means.

6. In a pile driver, the combination of hammer leads comprising smooth plane surfaces, a hammer unit guided therein, means disposed within the plane of said leads and cooperating with the

smooth plane surfaces thereof for allowing said hammer unit to descend in said leads but preventing upward movement therein due to upward thrust against said hammer unit, a frame carried by said hammer unit, a sheave mounted in said frame, and means carried by said sheave and connected with said cam means and actuatable from the lower portion of the pile driver for releasing said cam means.

7. In a pile driver, the combination of hammer leads comprising smooth plane surfaces, a hammer unit guided therein, a tackle connection for raising and lowering said hammer within said leads, one-way locking means allowing said hammer unit to descend in said leads but preventing upward movement of the hammer unit therein, said locking means comprising two spring plates disposed within the plane of said leads and having their ends secured to said hammer unit and having outer ends adapted to be sprung into locking engagement with the hammer leads, and means operable to release said locking means upon an upward pull transmitted through said tackle connection.

8. In a pile driver, the combination of hammer leads, a hammer guided therein, a frame secured to said hammer, a hammer hoisting line, a sheave on said hammer hoisting line, means for supporting said sheave in said frame for limited vertical movement relative thereto, locking means carried by said frame, and allowing said hammer to descend in said leads but preventing the hammer unit from being moved upwardly therein due to upward thrust against the lower end of said hammer, and means connecting said locking means with said movable sheave supporting means whereby said locking means can be released by upward pull transmitted through said hoisting line.

9. Apparatus of the class described for withdrawing from the ground a casing surrounding a formed concrete pile comprising a pile driver having in combination hammer leads, withdrawing means connected with the casing and the hammer leads and thereby acting to transmit the reaction pressure of withdrawal directly to the latter, and means connected between the hammer leads and the concrete pile for transmitting the reaction imposed on the hammer leads by the withdrawal pressure to the concrete pile.

10. Apparatus of the class described for withdrawing from the ground a casing surrounding a formed concrete pile comprising a pile driver having in combination hammer leads, withdrawing means connected with the casing and the hammer leads and thereby acting to transmit the reaction pressure of withdrawal directly to the latter, a hammer unit, a core carried by said hammer unit, said core seating on said formed pile during the withdrawal of said casing, and means connecting said hammer unit with said hammer leads for transmitting the reaction pressure imposed upon said leads to said hammer unit and core and through said core to said concrete pile.

11. Apparatus of the class described for withdrawing from the ground a casing surrounding a formed concrete pile comprising a pile driver having in combination hammer leads, withdrawing means comprising pulleys secured to said hammer leads, a hoisting yoke connected with said casing, pulleys secured to said hoisting yoke, cables connecting the pulleys on said hammer leads with the pulleys on said hoisting yoke, means connected to one end of said cables for

operating the same through the pulleys, the other ends of said cables being secured directly to said hammer leads whereby the reaction pressure of withdrawal will be transmitted directly to said hammer leads, and means connected between the hammer leads and the concrete pile for transmitting the reaction imposed on the hammer leads by the withdrawal pressure to the formed concrete pile.

- 10 12. Apparatus of the class described for withdrawing from the ground a casing surrounding a formed concrete pile comprising a pile driver having in combination hammer leads, withdrawing means comprising pulleys secured to said hammer leads, a hoisting yoke connected with said casing, pulleys secured to said hoisting yoke, cables connecting the pulleys on said hammer leads with the pulleys on said hoisting yoke, means connected to one end of said cables for operating the same through the pulleys, the other ends of said cables being secured directly to said hammer leads and thereby acting to transmit the reaction pressure of withdrawal directly to said hammer leads, a hammer unit carried by and guided for vertical movement in said hammer leads, a core secured to said hammer unit and seating on said formed concrete pile during withdrawal of the casing, and means secured to said hammer unit and cooperating with said hammer

leads for preventing upward movement of said hammer unit in said hammer leads, whereby the reaction pressure imposed upon said hammer leads will be transmitted to said hammer unit and core and through said core to the formed concrete pile. 5

13. Apparatus of the class described for withdrawing from the ground a casing surrounding a formed concrete pile, comprising a pile driver having, in combination, hammer leads, withdrawing means connected with the casing and the hammer leads and thereby acting to transmit the pressure of withdrawal directly to said hammer leads, mechanism guided for vertical movement between said hammer leads and comprising a core adapted to bear against the top of the concrete pile, and locking means carried by said mechanism and adapted to establish locking engagement with said hammer leads for preventing upward movement of said concrete pile during withdrawal of the casing, said locking means normally permitting said mechanism to move downwardly relatively to said hammer leads, whereby said core can follow directly any downward movement of the concrete pile in the withdrawal of the casing, said locking means normally preventing said mechanism from moving upwardly relatively to said hammer leads. 10 15 20 25

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