May 27, 1952 E. A. SMITH 2,598,454

DRILLING APPARATUS

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FIG. 2

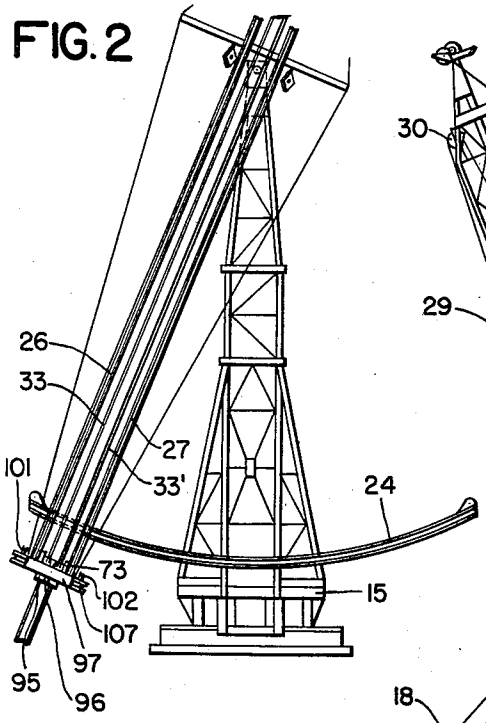


FIG. 1

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DRILLING APPARATUS

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FIG. 3

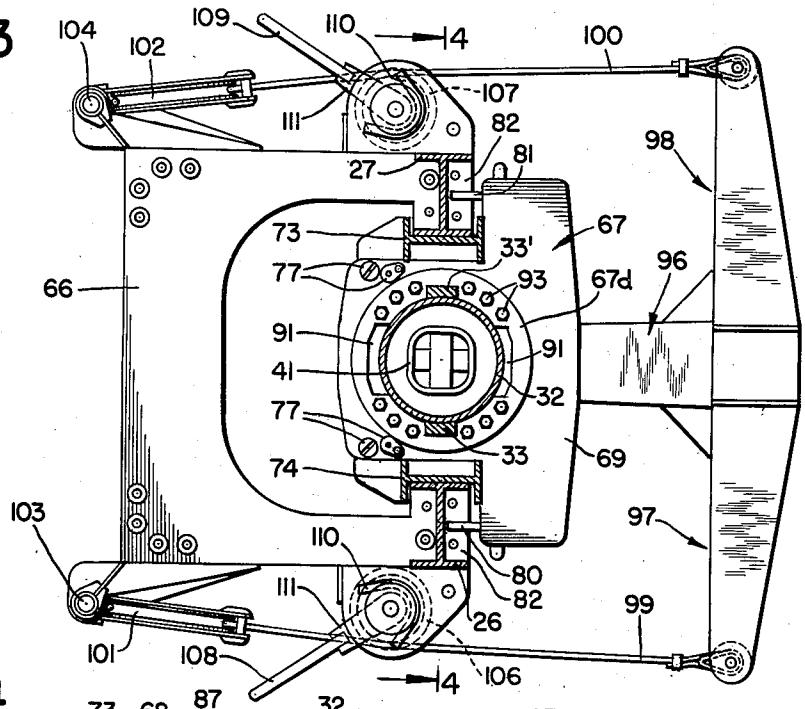
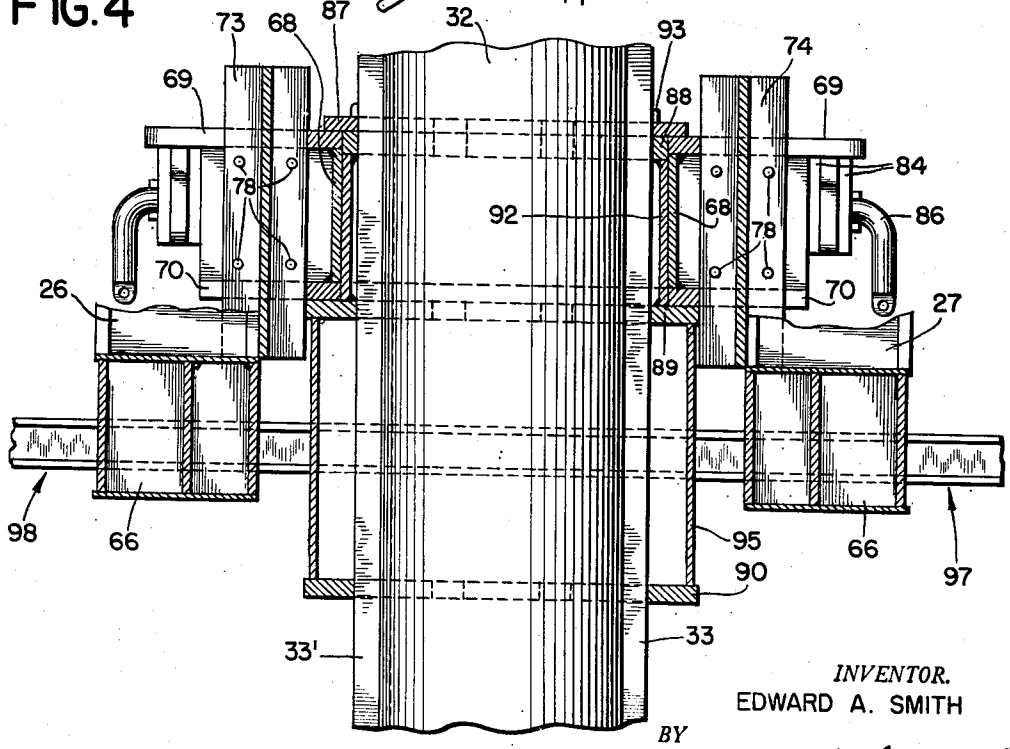


FIG. 4



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DRILLING APPARATUS

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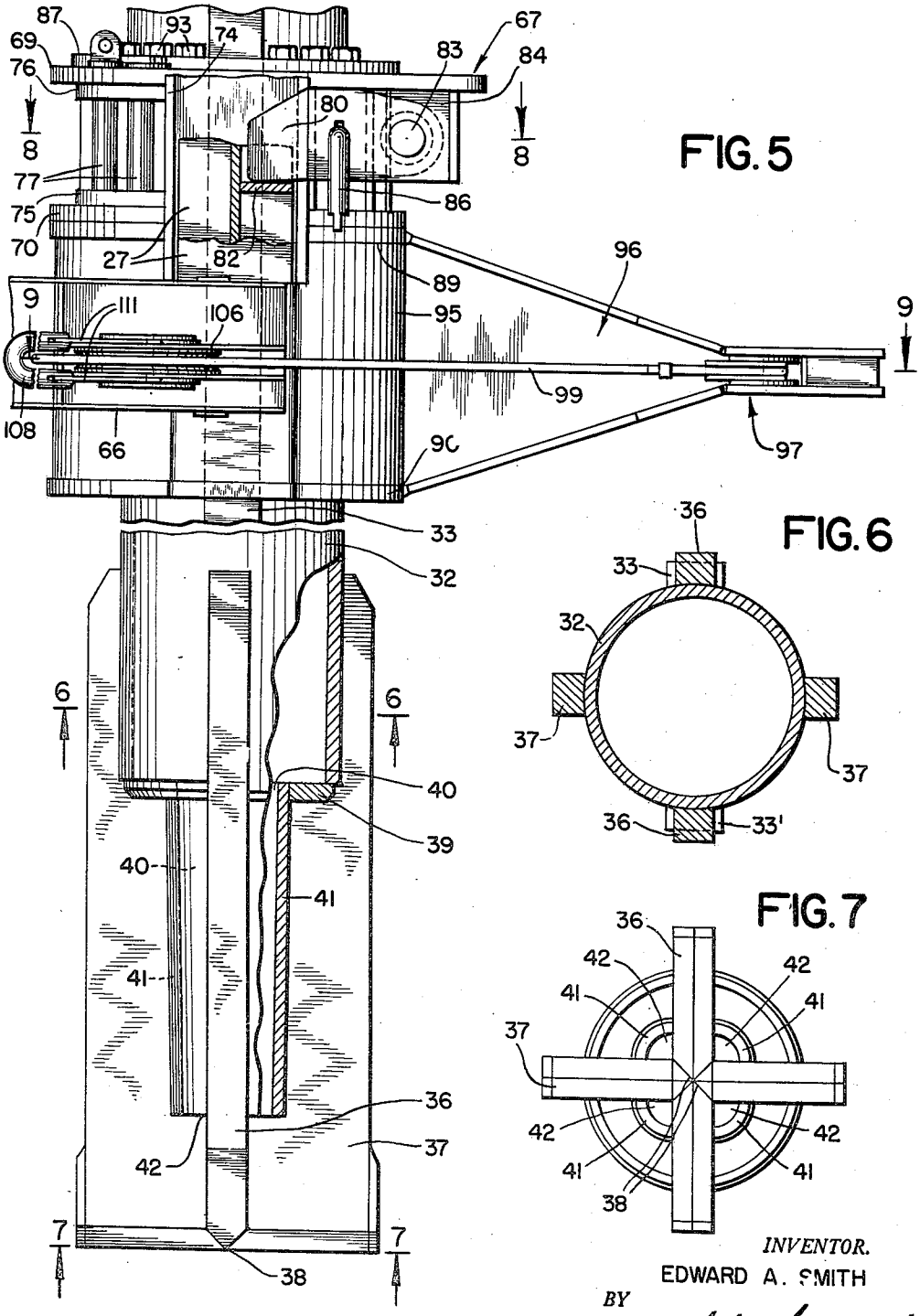


FIG. 5

FIG. 6

FIG. 7

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DRILLING APPARATUS

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FIG. 9

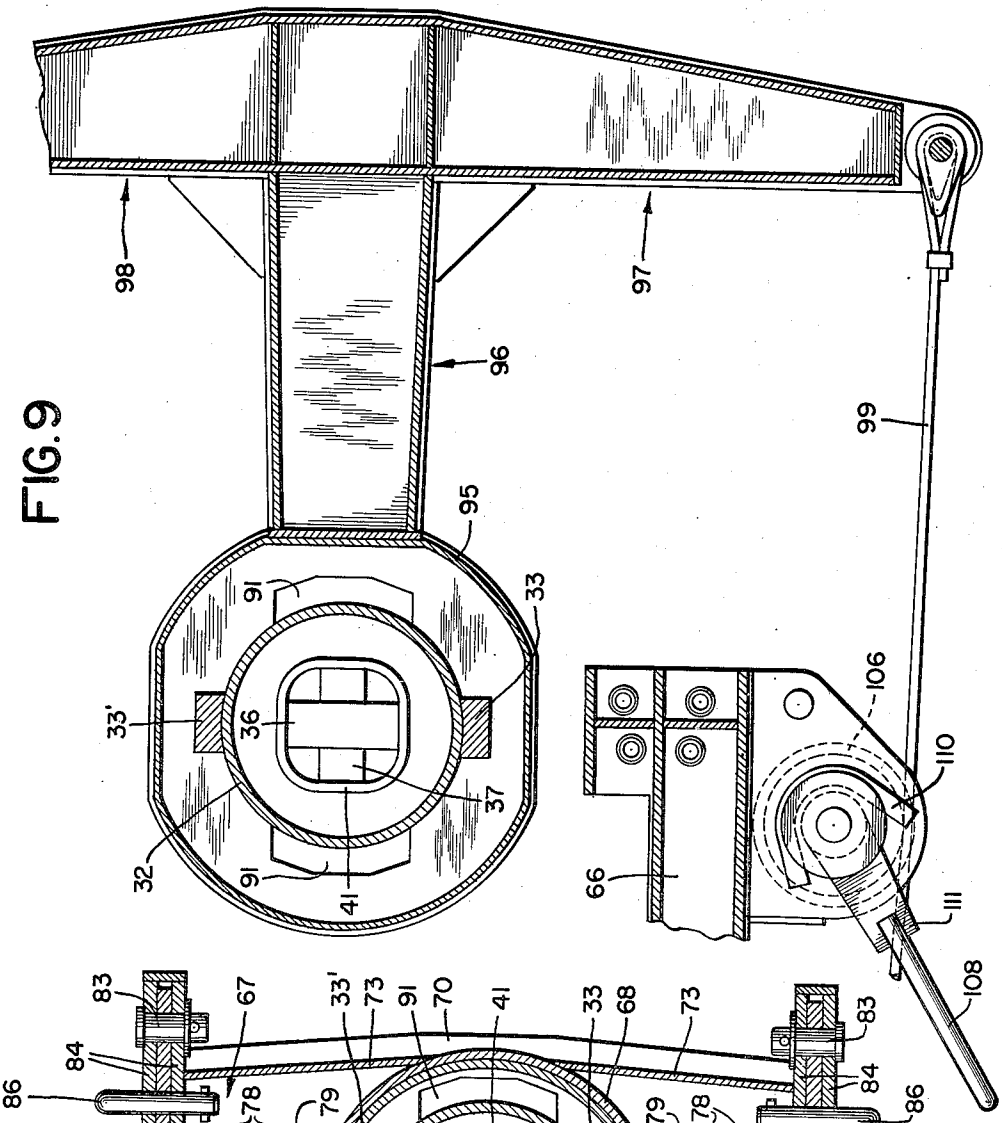
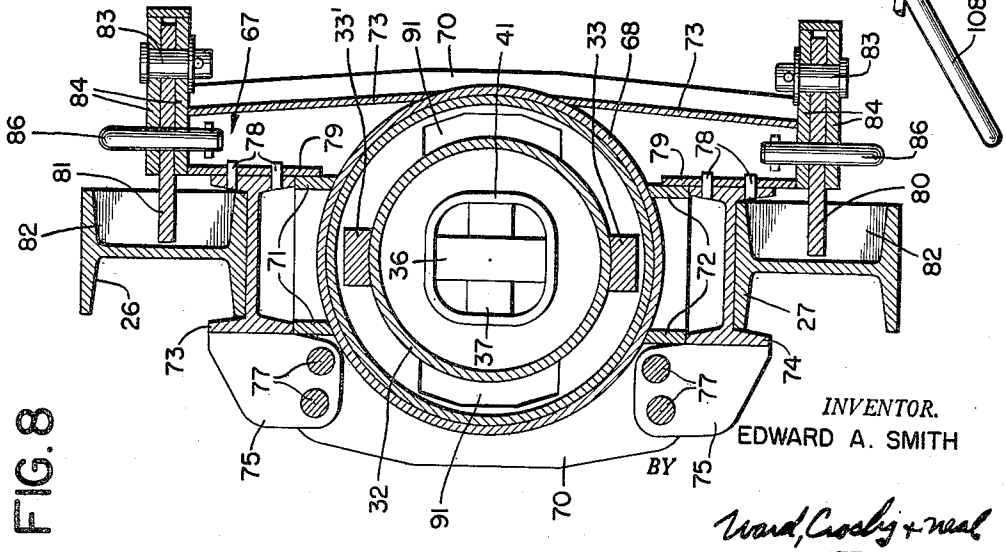


FIG. 8



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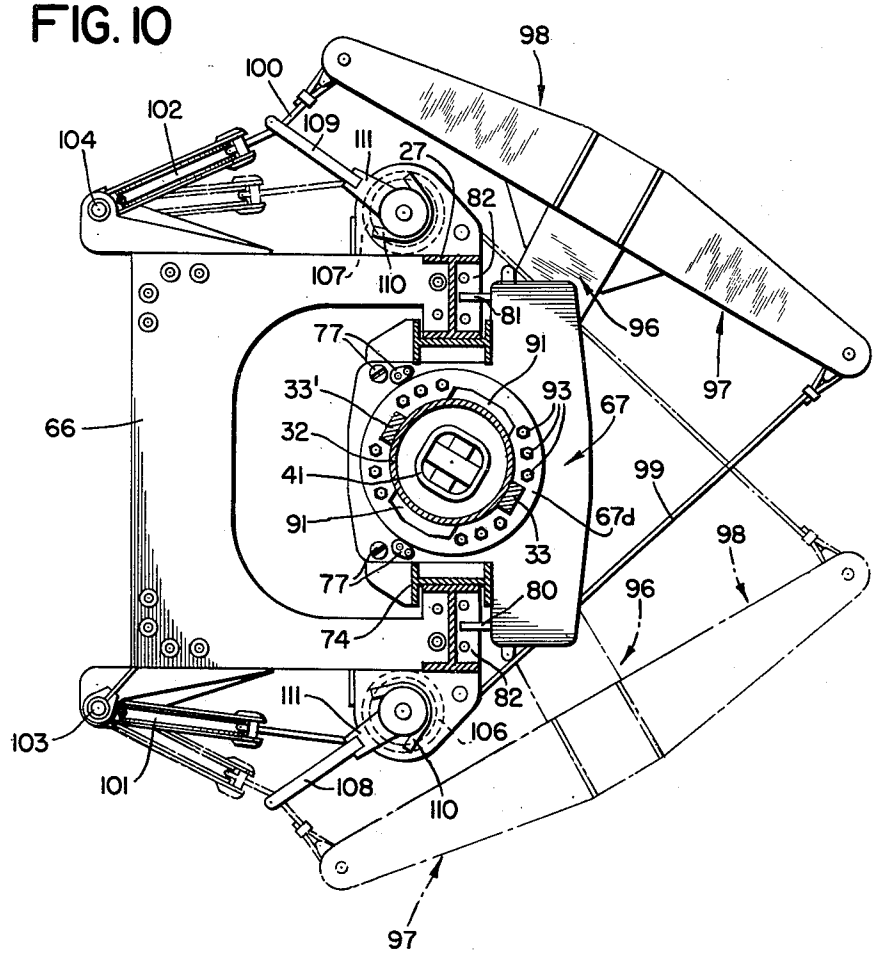
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DRILLING APPARATUS

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FIG. 10



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FIG. 11

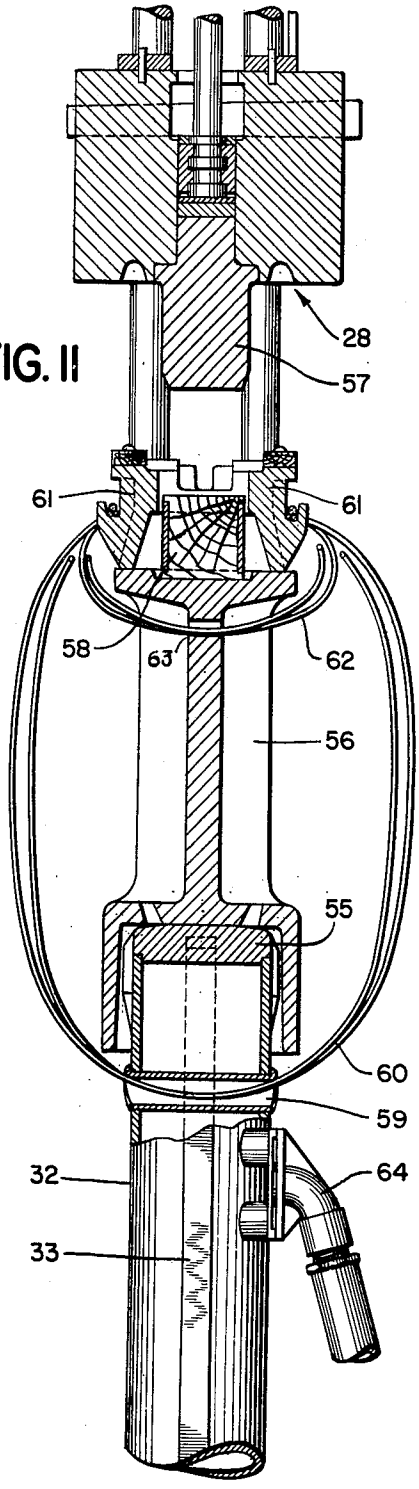
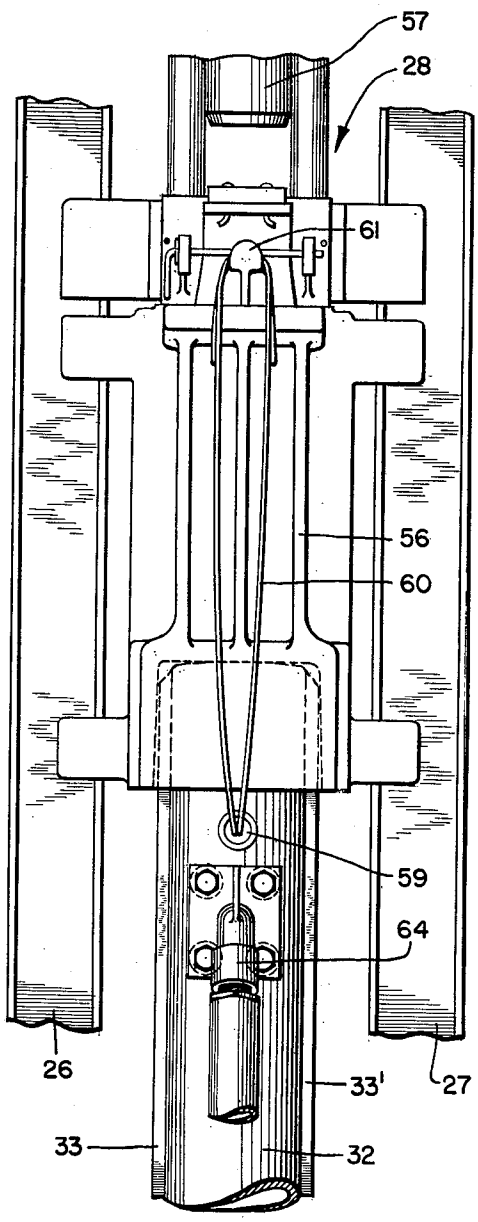


FIG. 12



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DRILLING APPARATUS

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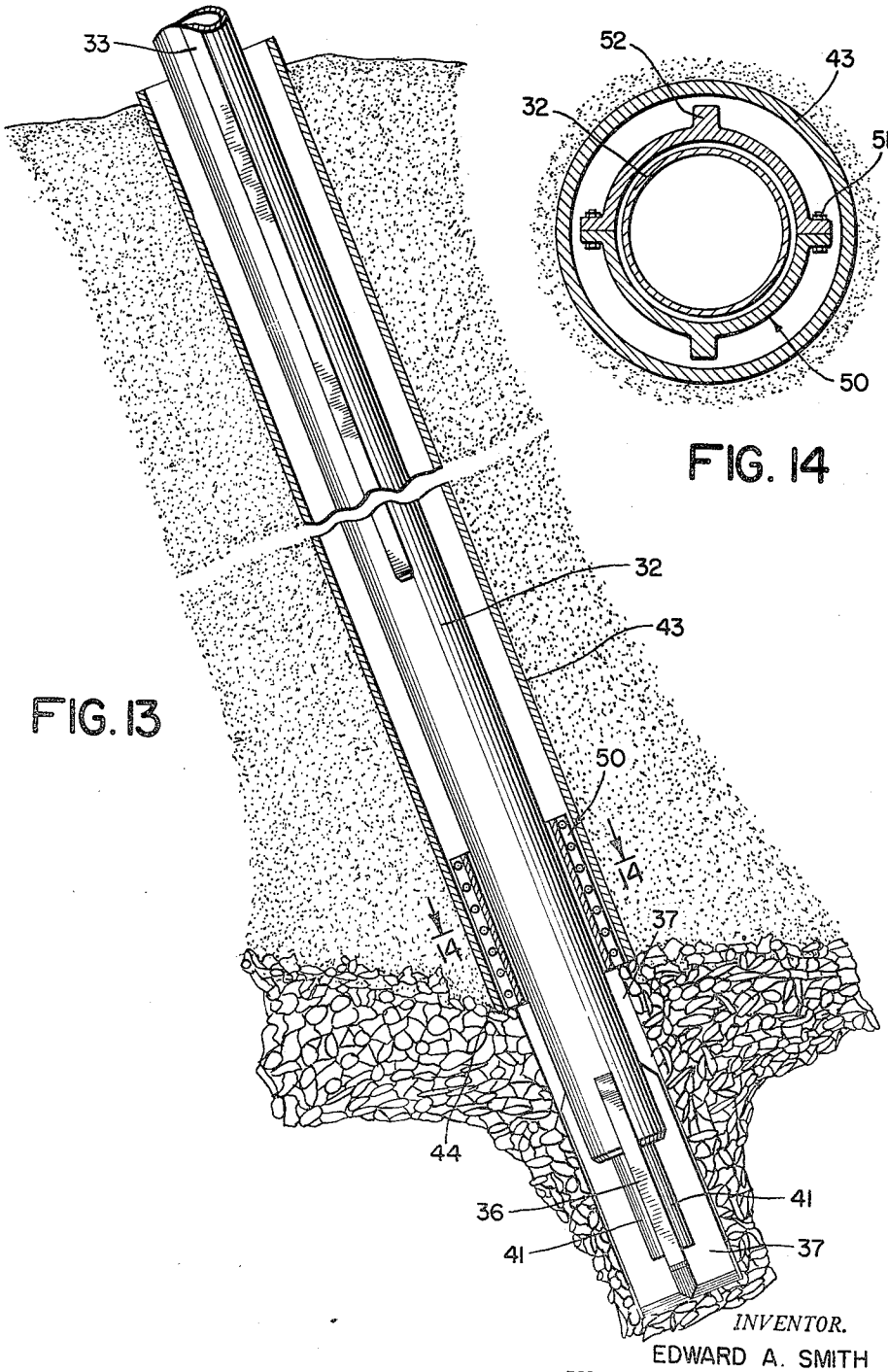


FIG. 13

FIG. 14

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UNITED STATES PATENT OFFICE

2,598,454

DRILLING APPARATUS

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Application June 2, 1950, Serial No. 165,736

5 Claims. (Cl. 255—19)

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This invention relates to drilling apparatus and more particularly a novel arrangement of equipment adapted to be combined and used with pile drivers to convert same into means for handling and operating drills.

Pile driving equipment of a well known type comprises a rotatably mounted platform or carriage upon which there is mounted an elongated upstanding structure having guide rails for receiving a steam hammer assembly which is slidable by power hoisting means to various elevations along the guide rails. This structure is usually pivotally connected at its base to a horizontally slidable extension for the carriage and also connected to boom means controlled by suitable tackle, all operable by power means on the carriage to control the position of said upstanding structure whereby the guide rails thereof may be tilted downwardly and forwardly, rearwardly or outwardly to either side of the carriage, and also whereby, in view of the rotatable mounting of the carriage, the guide rails may be directed in various positions at substantially any inclination desired for driving piles or caissons at a corresponding inclination.

In installing various types of hollow steel piles or caissons it is customary to drive them with equipment such as above described at the desired position and angle, or verticaly down to a rock footing, and in order to insure that the lower end will remain in place and distribute its load throughout the rock, it is sometimes the practice to drill a hole into the rock concentric with the lower end of the pile or caisson shell and then fill such hole as well as the shell with concrete reinforced with a steel H-member or otherwise if desired.

Prior to my invention, so far as I am aware it has been the general practice for such drilling to employ conventional types of drilling equipment, such for example, as ordinary oil well rotary drilling apparatus, but this requires setting up special equipment to handle, rotate and control the drill. On the other hand with the present invention only a few relatively simple parts and attachments are necessary to convert a pile driver into a form of apparatus suitable for performing the drilling by utilizing the power means and derrick equipment already available upon the pile driver. And since, where the equipment of this invention is to be used, a pile driver will usually already be present on the job for pile or caisson driving purposes, the expense and inconvenience of bringing to the site additional equipment for drilling purposes is largely obviated.

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However, it will be understood that the invention is useful for drilling as well in cases where no pile or caisson is first driven, and the invention is particularly useful in cases where the drill holes are to be made at a variety of different inclinations.

Further and more specific objects, features and advantages of the invention hereof will appear from the detailed description given below, taken in connection with the accompanying drawings which form a part of this specification and illustrate by way of example a preferred embodiment of the invention.

In the drawings:

Fig. 1 is a somewhat schematic elevational view showing a pile driver which has been converted and combined with drilling apparatus in accordance with the invention. Fig. 2 is a view of the lower half of the guide rails and supporting structure thereof of the pile driver and showing the apparatus when the guide rails are so positioned for drilling a hole at an inclination to one side of the pile driver platform or carriage. Fig. 3 is a sectional view taken substantially along line 3—3 of Fig. 1. Fig. 4 is a vertical sectional view taken substantially along line 4—4 of Fig. 3. Fig. 5 is a side elevational view of a portion of the equipment of Fig. 3, certain of the parts being broken away. Figs. 6 and 7 are views taken substantially along lines 6—6 and 7—7 of Fig. 5 respectively. Fig. 8 is a horizontal sectional view taken substantially along line 8—8 of Fig. 5. Fig. 9 is a sectional view taken substantially along line 9—9 of Fig. 5. Fig. 10 is a view similar to Fig. 3, but showing the parts oscillated to a different position. Fig. 11 is a vertical sectional view of the upper portion of the drill stem as detachably connected to the steam hammer assembly. Fig. 12 is an elevational view of the part of the equipment shown in Fig. 11. Fig. 13 is a vertical sectional view of the lower end portions of the drill in operation for drilling a hole at the lower end of a hollow pile or caisson; and Fig. 14 is a sectional view taken substantially along line 14—14 of Fig. 13.

Referring now more specifically to Fig. 1, the pile driver as here shown comprises a platform or carriage 15 rotatably mounted by suitable known means 16, and carrying a boom-like means 17 which is adjustable by suitable tackle 18 operable by power driven means generally indicated at 19 on the rear portion of the carriage 15. Means such as indicated at 20 is mounted on the forward end of the carriage to be slidable in and out under the control of the power

equipment, such means 20 at its outer end being pivotally connected as at 21 to an elongated upstanding structure 22, the mid portion of which is pivotally connected as at 23 to the upper end of the boom means 17. Thus, in the usual way the structure 22 may be moved to various inclinations pointing downwardly and forwardly, or downwardly and rearwardly, depending upon the position of the slide means 20 and the inclination of the boom means 17 as pivotally connected to the structure 22 at 23. As further shown in Fig. 2 the outer end of the slidable means 20 may if desired be provided with an arcuate guiding means 24 along which the lower end of the structure 22 may be moved to tilt the said structure to inclined positions directed toward the ground at either side of the carriage.

On the structure 22 a pair of guide rails 26, 27 are mounted for slidably receiving a steam hammer assembly as at 28, the elevation of which may be adjusted along the guide rails by a cable 29 running over pulleys as at 30 and down to the power hoisting apparatus on the carriage 15.

The portions of the equipment of Figs. 1 and 2 as thus far specifically described constitute parts of a known form of pile driver, and for such details thereof as are not hereinabove specifically described, reference may be had to such well known forms of pile drivers.

An elongated hollow drill stem 32 is adapted to be positioned between the two guide rails 26, 27 and to be slidably and oscillatably retained in such position by attachments to the pile driver hereinafter described. Two or more longitudinally extending key portions as at 33, 33′ are secured as by welding along the greater part of the length of the drill stem and these are adapted to be slidably received by wrench means for oscillating the drill stem as hereinafter described, such wrench means together with retaining means therefor being located at 34 adjacent the lower end of the structure 22.

Reference is now made to the lower end of the drill stem as shown in Figs. 5–7, and 13, 14. As best shown in the lower part of Fig. 5 and in Fig. 7 a pair of steel plates 36, 37, sharpened at their lower edges as at 38, are welded in place at right angles to each other to provide the cutting means. At the lower end of the hollow stem 32 a plate as at 39 is welded in place for closing off such end except for passages as at 40 formed by channel shaped members 41, each of which is welded along one of the right angle corners formed by the members 36, 37 so as to provide four discharge outlets 42 communicating with the hollow interior of the stem 32 and serving to discharge water or other fluid therefrom to points adjacent the cutting edges 38.

In Fig. 13 the lower portions of the drill are shown in a position extending down through a hollow pile or caisson shell 43 which has been previously driven to rock footing as at 44. It will be understood that after this shell is put in place the drill as handled by the pile driver equipment is slipped down through the shell into drilling position. But first an annular guide means generally indicated at 50 is preferably placed around the drill stem just above the cutting members 36, 37, this guide means being for the purpose of centering the drill with respect to the caisson or pile shell while at the same time allowing the drill to gradually slide down therethrough as the drilling proceeds. As shown in Fig. 14 the guide means 50 may comprise simply a pair of semi-cylindrical members having flanges bolted together as at 51 and having such additional longitudinally extending spacer flanges at 52 as may be desirable to space the drill assembly uniformly from the inside walls of the pile or caisson shell.

The upper end of the drill stem 32 as shown in Fig. 11 is preferably covered by a driving head or cap 55 preferably sealed in place and adapted to be received within the lower socketed end of a hammer follower piece 56 which may be of a suitable known construction, such as heretofore used as a follower for steam hammers in the driving of piles. The steam hammer assembly 28 as shown in Fig. 11 may be of a suitable conventional type having a ram 57 adapted to strike a wooden block as at 58 retained on top of the follower 56.

The upper end of the drill stem is preferably formed with the transversely extending tubular piece 59 welded and sealed in place to provide an aperture for receiving a cable sling or loop 60 for loosely and detachably securing the drill stem to the hammer. That is, the lower portion of the hammer assembly is provided with hook portions 61 such as usually used for attaching a follower and these are here used for hooking engagement with the two ends of the loop 60. The follower 56 may similarly be detachably connected to the hammer assembly by a loop or sling 62, the mid portion of which passes through apertures 63 in the follower and the ends of which also engage on hook portions 61 in the usual way of securing the pile driving follower in place with respect to the hammer.

The upper portion of the hollow drill stem 32 is provided with a hose connection 64 for introducing a supply of water or other liquid into the stem to flow down about the cutting edges of the lower end of the drill as above described. Since the drill stem in operation is merely oscillated and not rotated continuously as is the case with the usual rotatable drill, the water connection at 64 does not need to be a swiveled attachment.

Referring now more particularly to Figs. 3–5, 8 and 9, the guide and wrench means at the base of the structure 22 for holding the drill stem in position and oscillating same, will now be described.

A fabricated steel yoke means 66 has its two branches rigidly and permanently affixed to the lower ends of the guide rails 26, 27 respectively. The guide means generally indicated at 67 (see Figs. 3 and 3) may include a cylindrical portion 68 within which is rotatably received a portion of the wrench means hereinafter described. Cylindrical portion 68 is welded at its upper and lower ends to plates 69 and 70 (Figs. 4 and 5). Also vertical fins as at 71, 72 are welded to opposite sides of the member 68 (Fig. 8) and webs 73 are welded to member 68 and to the top and bottom plates of the guide assembly. Adapter means are provided at each side of this arrangement, permitting same to be removably and slidably received between the guide rails 26 and 27. Such adapter means may comprise a pair of runners 73, 74 of I-shaped cross section, and between the flanges of which the guide rails 26, 27 are received, as will be apparent in Fig. 8. A pair of plate-like lugs as at 75, 76 (Figs. 5 and 8) are welded at vertically spaced points to each of the members 73, 74, and removable pins at as 77 are positioned in apertures passing down through plate 69, plate-like lugs 76, 75 and plate 70. Each of the members 73, 74 also has protruding from one side thereof, a plurality of pins as at 78 which are

removably received in corresponding apertures in web portions 79 which are welded to and form a part of the guide assembly 67. Thus when the pins 77 are removed, the entire guide means assembly 67, together with the wrench means hereinafter described as carried thereby, may be removed to one side of the guide rails 26, 27, but when the pins 77 are in place, the adapter means comprising the runners 73, 74, the lug plates 75, 76 welded thereto, and the pins 78, serve to hold the entire guide means in a position between the guide rails 26 and 27 and the guide assembly as a whole in such position is slidable up and down the guide rails 26, 27.

In order to limit downward sliding of the guide assembly 67, finger members 80, 81 normally protrude into the space between the flanges of guide rails 27, 26 respectively and rest upon webs as at 82 welded in place between such flanges. These fingers are each pivotally mounted on removable pins as at 83 which pass through a pair of webs as at 84 suitably welded to the guide assembly 67, the fingers 80, 81 being movable arcuately about the pins 83 while held between the webs 84 (see Figs. 5 and 8). The fingers 80, 81 are normally held in active position by removable pins as at 86. When these pins are removed and the whole guide assembly 67 is elevated somewhat (as by using the power hoisting facilities of the pile driver), it will apparent from Fig. 5 that the fingers 80, 81 will be free to swing about their pivoting pins 83 so that their inner ends will drop down and thereafter the whole guide assembly will be free to be slid down out from between the lower ends of the guide rails 26, 27.

The wrench assembly for arcuately oscillating the drill stem may comprise four annular rings 87, 88, 89 and 90 (Fig. 4), each of which is formed with internal notches to slidably receive the keys 33, 33' on the drill stem 32 (see Fig. 8) and also with such further internal notches as at 91 as may be necessary to enable the wrench means to be slid onto the drill stem either over the lower end or over the water connections etc. at the upper end. As shown in Fig. 4, annular rings 88 and 89 respectively are welded to the upper and lower ends of a cylindrical member 92 which is rotatably received within the cylindrical portion 68 of the guide assembly. The upper annular ring 87 is removably secured as by bolts 93 to the annular ring 88. The external diameter of ring 87 is larger than the diameter of the central aperture through the guide assembly 67 so that this top ring serves to retain the wrench means against sliding down through the guide means, but when the wrench means is to be removed from the guide assembly, this may be accomplished simply by removing the bolts 93 to remove the upper ring 87 whereupon the wrench structure may be readily slid down out of the guide assembly.

The lower two annular rings 89, 90 respectively are welded to the upper and lower ends of a tubular member 95. Arm-like means generally indicated at 96 is of a fabricated construction welded to the rings 89, 90 and to the tubular member 95 and protrudes out to a pair of branches also of fabricated construction and generally indicated at 97, 98 (Fig. 9). Ropes or cables 99, 100 are secured to the outer ends of the parts 97, 98 respectively and upon applying tension to such cables alternately, the wrench structure, together with the drill stem, may be oscillated arcuately through about 120° as indicated by the parts shown in dotted and full lines in Fig. 10. Cables 99, 100 pass under and around sheaves 101, 102

respectively, the frames for which are pivotally mounted as at 103, 104 to the corners of the yoke member 66. From the sheaves 101, 102, the cables extend up along the structure 22 (Fig. 1) and over sheaves as at 105 and thence down to a spool-like drum or drums forming a usual part of the power-driven hoisting equipment at 19, the drum or drums being so driven and the cables being so wound thereon that tension may be alternately applied to the cables in any suitable known way.

The cables 99, 100, as shown in Fig. 3, normally are guided over sheaves as at 106, 107 mounted at the sides of the branches of the yoke 66, but as will be clear from Fig. 10, when the wrench means is moved to its extreme position in either direction, the cables will leave these sheaves and then, to control their positions, eyelet-like members as at 108, 109 may be provided, these members being pivotally mounted on the same axis as the sheaves 106, 107 and being free to swing within limits as determined by stop members 110 which are welded to the brackets 111 by which the eyelet-like members are pivotally carried.

In order to convert the pile driver into apparatus for drilling, the above-described wrench assembly may first be slid over the drill stem 32. The guide assembly 67 is then slid into place about the upper portion of the wrench assembly and there held in place by bolting on the upper annular ring 87. The power driven hoisting equipment of the pile driver may then be used by attaching a sling around the upper end of the drill stem to pull the drill stem up into an upright position between the guide rails 26, 27. Then, after the adapter means, including the runners 73, 74 are in place at the lower ends of the guide rails 26, 27, the guide assembly 67, as containing the wrench means and drill stem, may be lifted to the proper elevation by the power hoisting equipment of the pile driver and fitted into place between such adapter means and there retained by inserting the pins 77.

If the lower end of the drill stem is to be held in alignment with a pile or caisson shell as hereinabove described in connection with Figs. 13 and 14, the drill stem will have first been surrounded by the guide means of Fig. 14.

The upper end of the drill stem may now be removably attached to the hammer assembly 28 and follower piece 56 as above described in connection with Figs. 11 and 12, and upon applying the water connection at 64, the drilling apparatus will be ready for operation. The pile driver hammer is then put into operation in the usual way, and as the drill stem is arcuately oscillated, drilling will proceed. After drilling of the hole is completed, it will be apparent that the parts which are used to adapt the pile driver for drilling purposes, may all readily be removed to permit the pile driver to then be used again for driving piles for caissons.

With the above described embodiment of the invention, it will be noted that the drill stem is held and guided at its lower end by the guide means 50 and at a point intermediate its length by the guide assembly 67, and also the upper end of the drill stem is retained against any substantial displacement by reason of the detachable connections to the hammer assembly. Of course if necessary or desired, additional guide means may be provided for the drill stem at intermediate points along the structure 22.

While the invention has been described in detail with respect to a particular preferred ex-

ample, it will be understood by those skilled in the art after understanding the invention, that various changes and further modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent is:

1. Pile driving apparatus adapted for alternative use for drilling purposes, comprising in combination: a pile driver assembly of the type having guide rails; a fluid pressure operated pile driving hammer assembly slidable by the power hoisting means of the apparatus to various elevations along said guide rails, said guide rails being adjustable in position by the power hoisting means; an elongated drill stem adapted to extend along between said guide rails and formed with longitudinal key means, said drill stem being detachably and oscillatably connected at its upper end to the hammer assembly; guide means for slidably and oscillatably receiving the drill stem and detachably secured to the lower ends of said guide rails; wrench means slidably engaging said drill stem key means for oscillating the drill stem, said wrench means also being detachably supported on the lower ends of said guide rails; and cables connected to oscillate said wrench means upon being alternately subjected to tension by the power means on the pile driver assembly.

2. Pile driving apparatus adapted for alternative use for drilling purposes, comprising in combination: a pile driver assembly of the type having guide rails; a fluid pressure operated pile driving hammer assembly slidable by power hoisting means of the apparatus to various elevations along said guide rails, said guide rails being adjustable in inclination by the power hoisting means; an elongated drill stem extending along said guide rails and formed with a longitudinally extending fluid passage; a connection rigidly secured at the upper end of said drill stem for bringing said passage into communication with a source of fluid supply, said drill stem being detachably connected at its upper end by a sling to the hammer assembly permitting oscillation of the drill stem; guide means for slidably and oscillatably receiving the drill stem and detachably secured to the lower ends of said guide rails; wrench means slidably engaging said drill stem adjacent said guide means for oscillating the drill stem; and cables connected to oscillate said wrench means upon being alternately subjected to tension by the power means on the pile driver assembly.

3. Pile driving apparatus adapted for alternative use for drilling purposes, comprising in combination: a pile driver assembly of the type having guide rails; a fluid pressure operated pile driving hammer assembly slidable by power hoisting means of the apparatus to various elevations along said guide rails, said guide rails being pivotally mounted intermediate the ends thereof for adjustment to various angles to the vertical, the power hoisting means having connections to said guide rails to affect such adjustments; an elongated drill stem adapted to extend along said guide rails; sling means for detachably connecting said drill stem at its upper end to the hammer assembly and permitting oscillation of the drill stem; guide means adapted to be detachably secured to the lower ends of said guide rails for slidably and oscillatably receiving the drill stem; detachable wrench means for slidably engaging said drill stem adjacent said guide means for oscillating the drill stem; and detachable connections for extending between said wrench means and the power means on the pile driver apparatus for oscillating said wrench means.

4. In combination with the hammer guide rails of fluid pressure operated pile driving hammer apparatus having power hoisting equipment: guide means detachably secured to the lower ends of said guide rails and having an aperture between said guide rails for slidably and oscillatably receiving a drill stem; a drill stem detachably and oscillatably connected at its upper end to the hammer assembly and extending down through said guide means; a wrench structure detachably supported in said guide means and slidably receiving said drill stem to oscillate same; and connections for oscillating said wrench means including a pair of cables running from the wrench means over pulleys and along the guide rails to the power hoisting equipment, for oscillating said wrench means.

5. In combination with the hammer guide rails of fluid pressure operated pile driving hammer apparatus having power hoisting equipment: guide means detachably mounted adjacent the lower ends of said guide rails and having an aperture between said guide rails for slidably and oscillatably receiving a drill stem; adaptor means having portions respectively embracing said guide rails and interposed between same and said guide means to retain the latter in position; a drill stem detachably and oscillatably connected at its upper end to the hammer assembly and extending down through said guide means; an oscillatable wrench structure detachably supported in said guide means and slidably receiving said drill stem to oscillate same; and connections for oscillating said wrench means including a pair of cables running therefrom to the power hoisting equipment.

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