Oct. 7, 1930. F. STONE ET AL 1,777,587

ROTARY TABLE AND PIPE GRIPPING MEANS THEREFOR

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Fig 1.

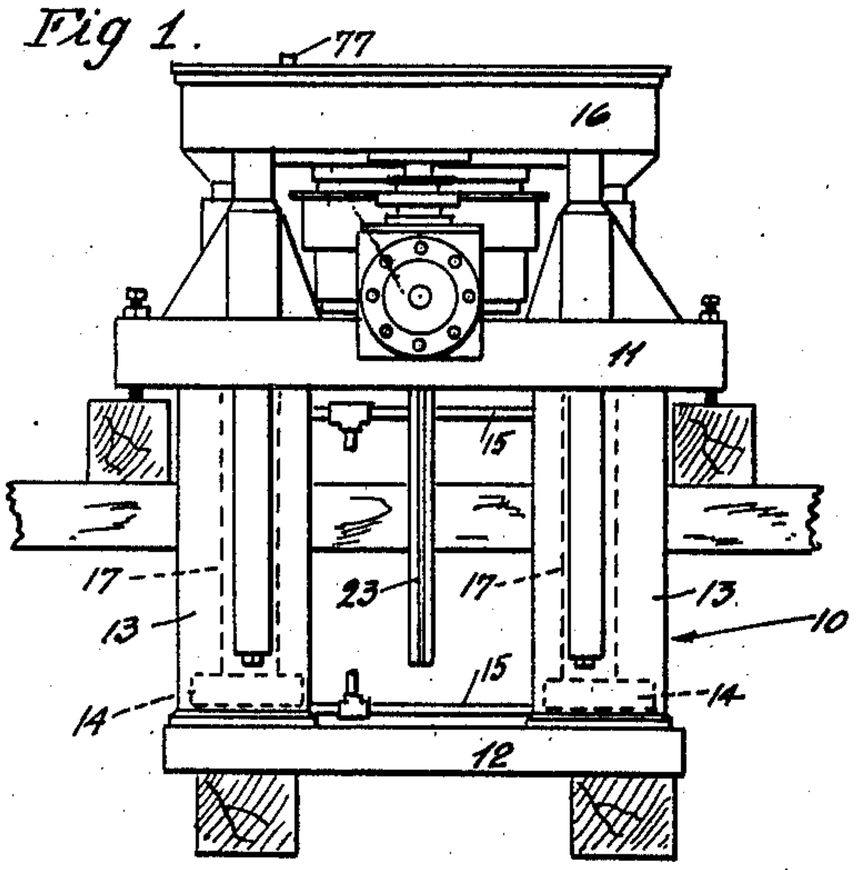



Fig. 2.

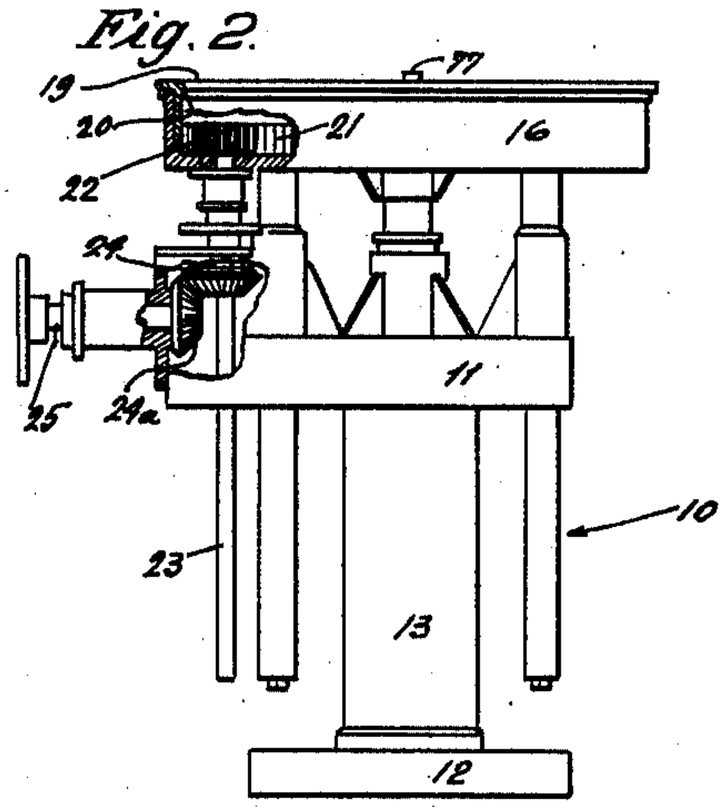



Fig. 3.

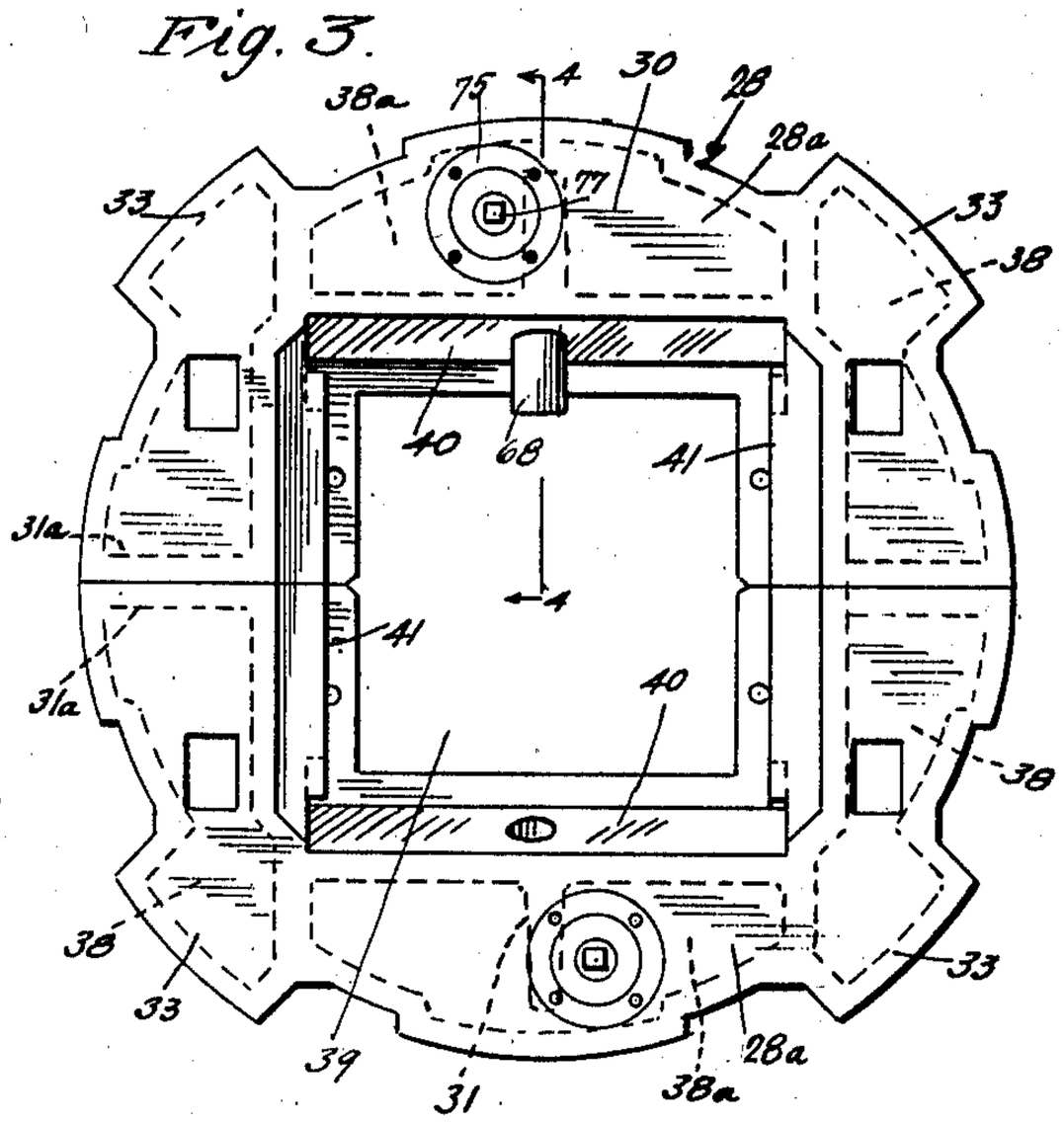
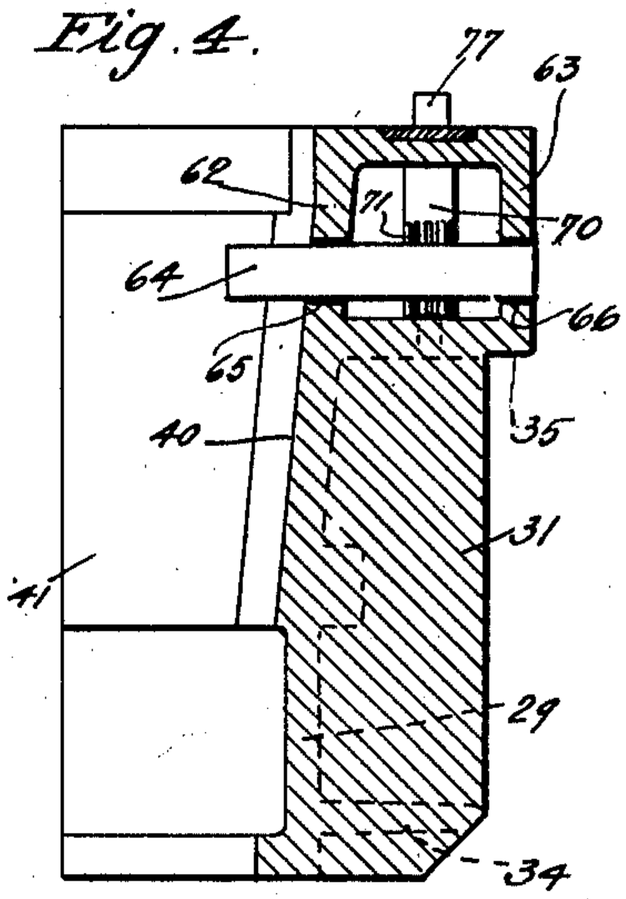



Fig. 4.

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ROTARY TABLE AND PIPE GRIPPING MEANS THEREFOR

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Fig. 5

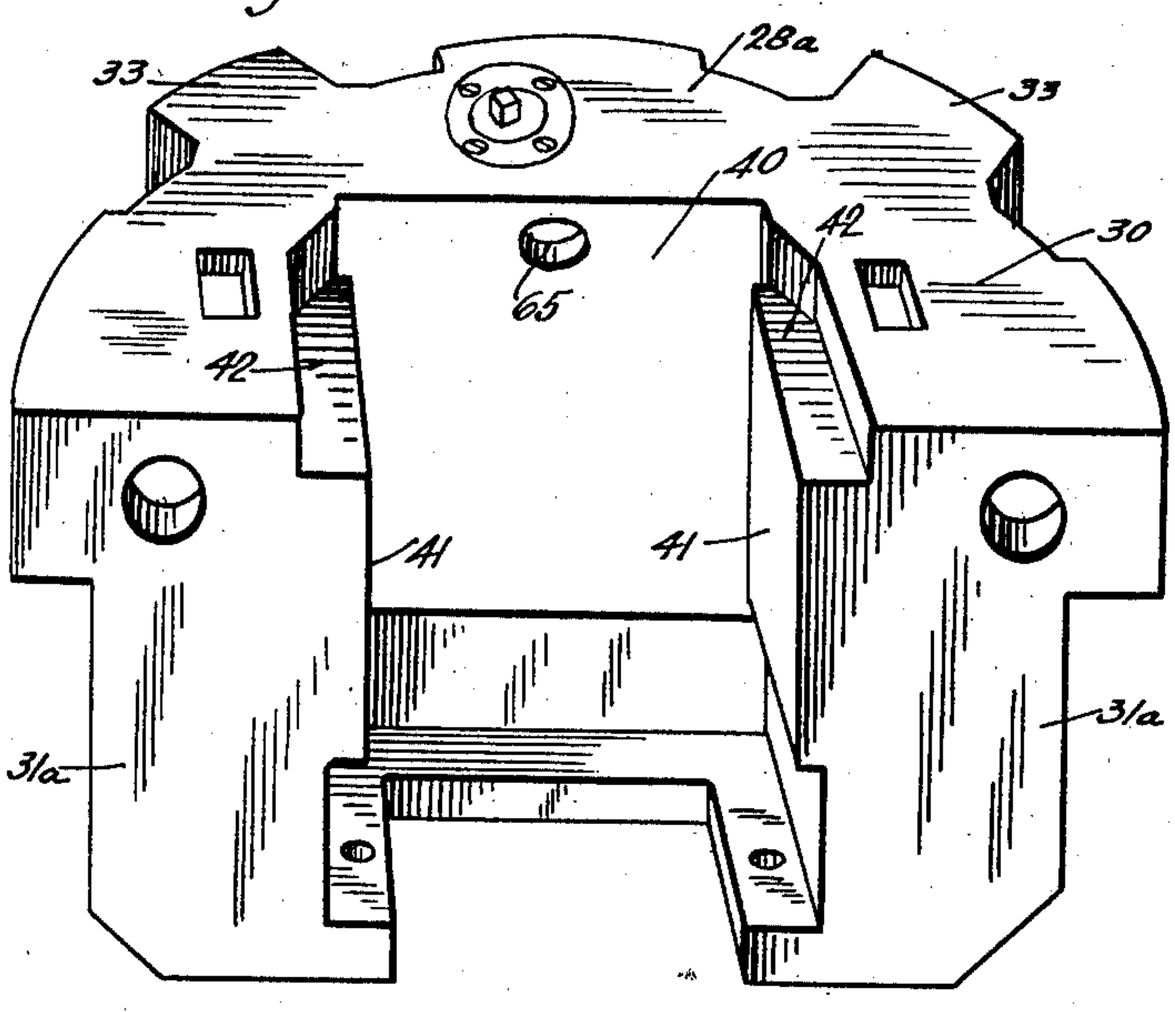



Fig. 10.

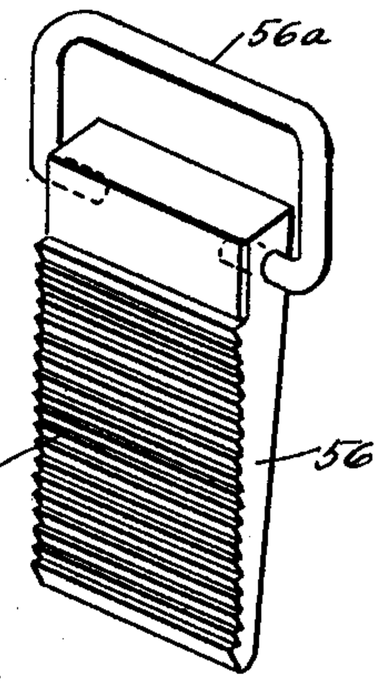



Fig. 6.

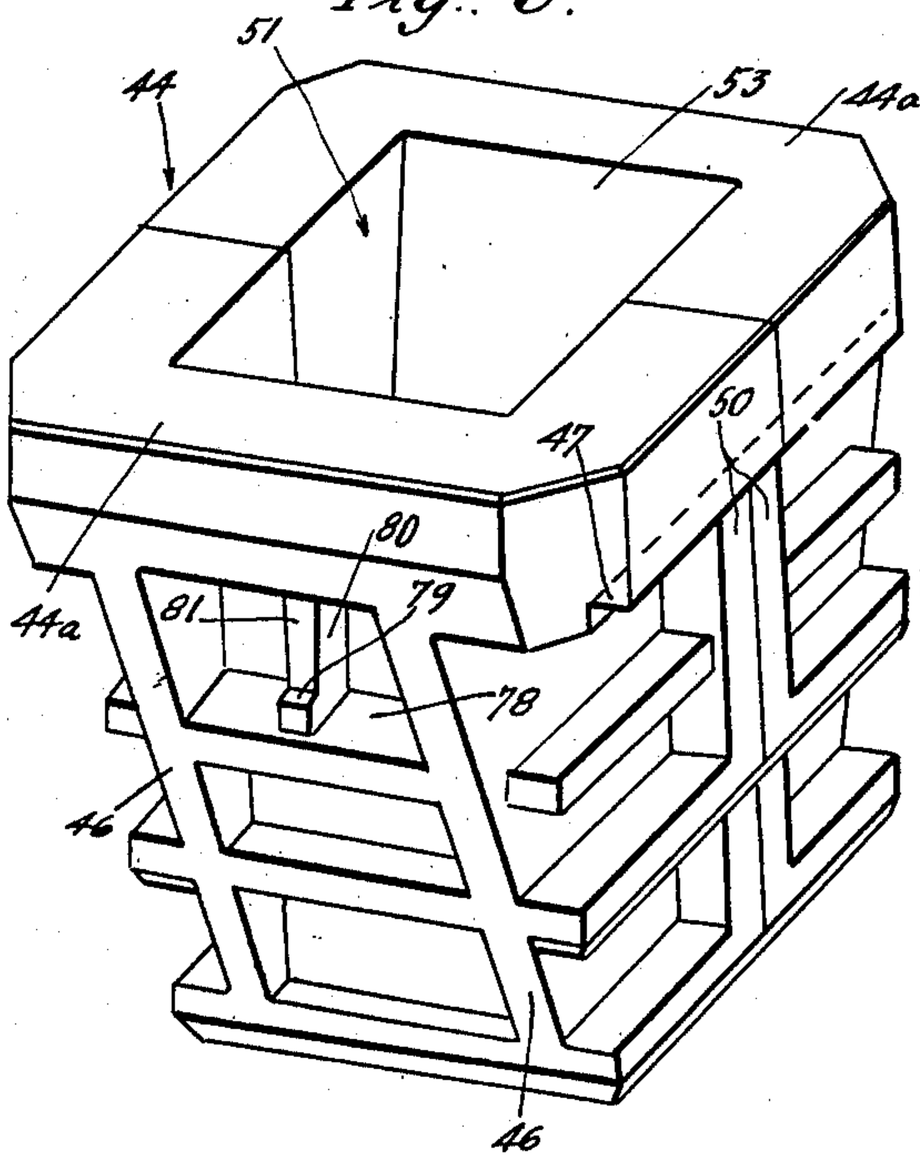
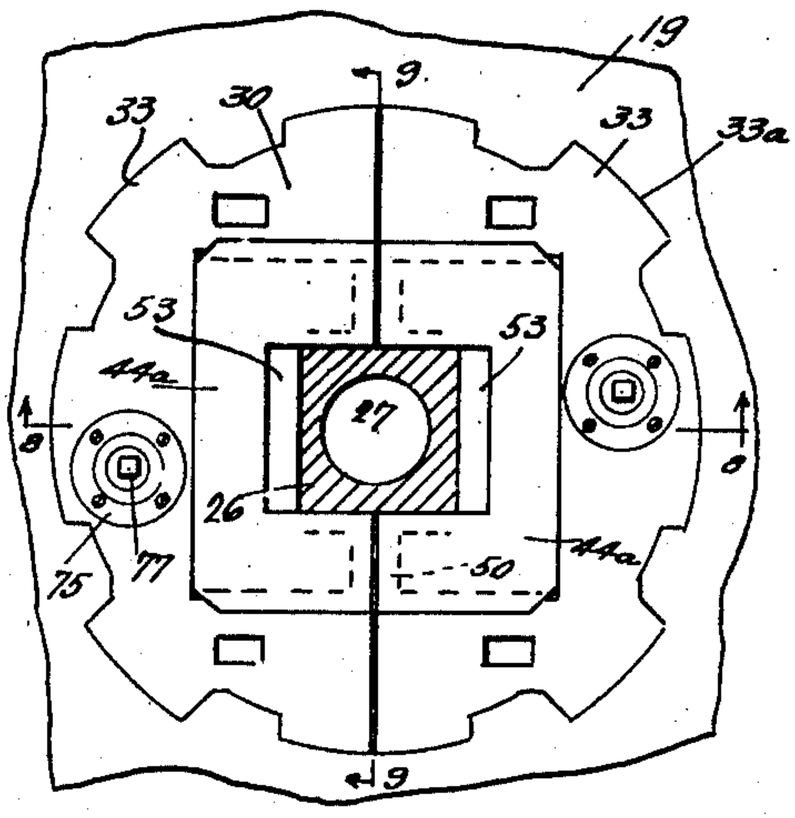



Fig. 7.

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ROTARY TABLE AND PIPE GRIPPING MEANS THEREFOR

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Fig. 8.

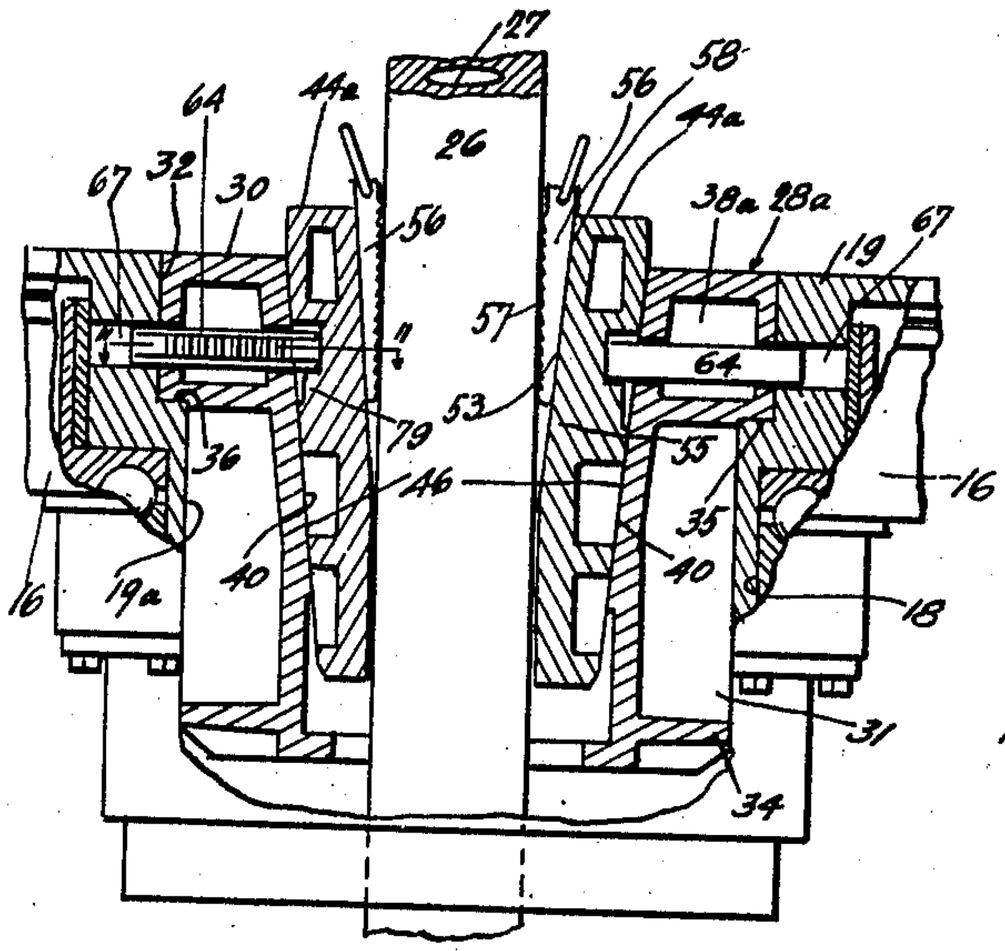



Fig. 9.

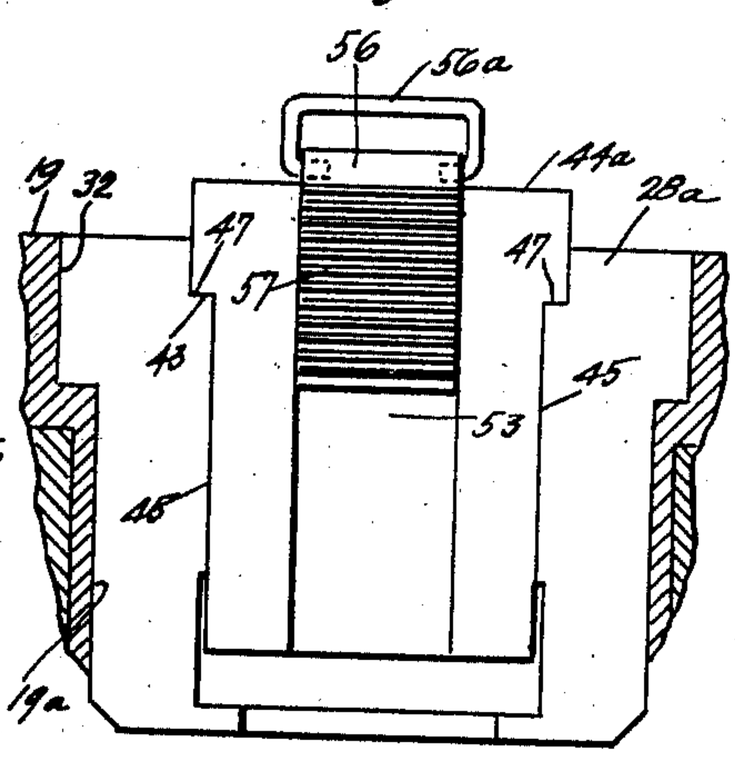



Fig. 11.

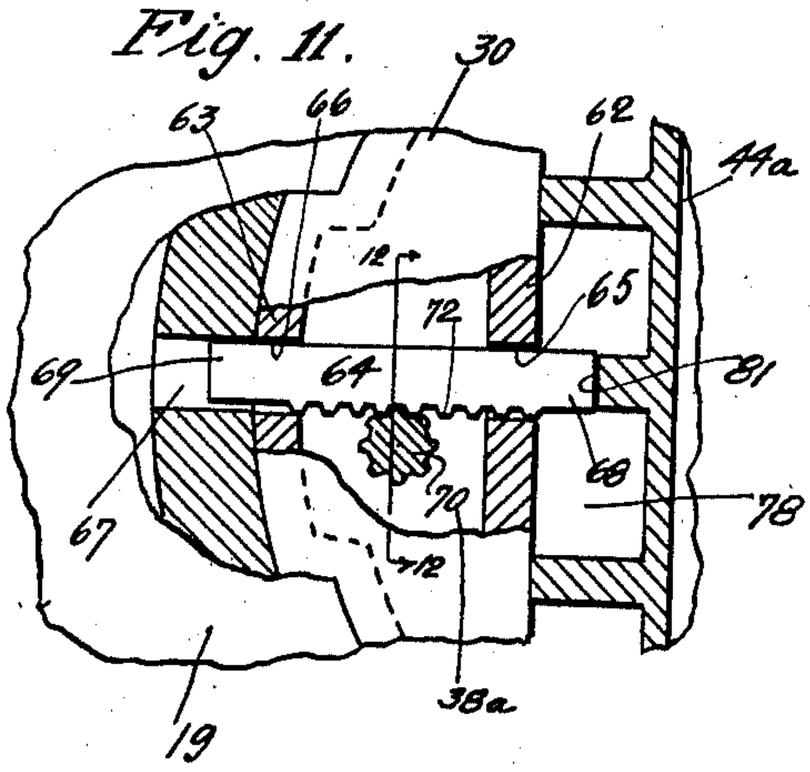
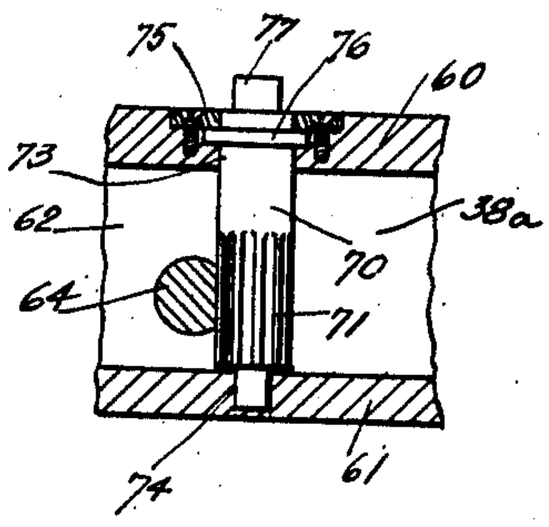



Fig. 12.

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# UNITED STATES PATENT OFFICE

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## ROTARY TABLE AND PIPE-GRIPPING MEANS THEREFOR

Application filed March 3, 1928. Serial No. 258,814.

This invention has to do with well drilling apparatus and is more particularly concerned with rotary tables and bushings therefor.

For reasons well known to those skilled in the art, it is customary to provide bushings for the axial bores of rotary tables, these bushings commonly being known as "table bushings" or "master bushings," the bushings in turn being adapted to take within their axial bores wedge slips, kelly bushings or other elements for imparting the drive of the table to the work which extends through the bushing bore, the particular nature of the work-encircling elements depending upon the individual nature of the work in hand and the particular operation to be performed thereon.

As a feature of the invention, we have provided a novel type of kelly bushings (that is, bushings having vertically extending axial openings of square cross-section and adapted to take square drill stem lengths which are commonly known as "grief pipes" or "kellys") particularly well suited for use in connection with rotary tables which are adapted to be reciprocated vertically or controlled in such reciprocation. When using this particular type of kelly bushing, dependence may be had upon the table only to rotate the drill stem, the weight of the drill stem being taken by and the feed of the bit being controlled through usual over-head tackle, the drill stem being adapted to pass downwardly through the bore of the kelly bushing as the drilling progresses.

However, upon occasions of power failure or line breakage in the hoisting tackle, it is often essential that the string be "picked up" to lift the bit from bottom until repairs have been made. With a hydraulically reciprocated table in use, the kelly bushings here shown are adapted in such situations to take wedge slips which grippingly engage the stem when the table is moved upwardly, it following that the bit may be lifted from bottom a distance equal to the stroke length of the table.

Furthermore, it is often desirable to take some of the weight of the drill stem on the table rather than impose it all on the bit, the table being lowered under hydraulic control to control the feed of the tool accurately. In such situations the cable feed devices are dispensed with and the wedge slips are used to grip the pipe in a manner to prevent its movement downwardly through the kelly bushing and hence downwardly with respect to the table. However, the complementary angularity of the bushing bore and kelly gives the necessary rotary driving connection and it is therefore unnecessary that the slips engage the pipe in a manner to prevent its rotation with respect to the bushing, to obvious advantage.

It is also sometimes of advantage to use these slips in connection with this particular type of bushing when it is desired to apply even and forceful upward pressure to the drill stem while it is being rotated, a force application which cannot be made with the requisite degree of ease and fineness of regulation through the use of ordinary hoisting tackle. Such an occasion sometimes arises in coming out of bad hole or through certain types of formation, as is well understood by those skilled in the art.

How we accomplish the above may be pointed out to better advantage in connection with the following detailed description, wherein further objects and novel features of the invention will be made apparent. Reference will be had to the accompanying drawings in which:

Fig. 1 is a front elevation of a rotary table with which our invention may be embodied;

Fig. 2 is a side elevation of Fig. 1, as viewed from the right thereof, parts being shown in broken away section;

Fig. 3 is a top plan view of a preferred type

of table bushing used in connection with our invention;

Fig. 4 is a section on line 4—4 of Fig. 3, but showing the locking pin projected to a different position;

Fig. 5 is a perspective view of one of the table bushing parts;

Fig. 6 is a perspective view of kelly bushings which may be used in conection with the apparatus;

Fig. 7 is a fragmentary plan view of the table showing a table bushing and kelly bushing in place;

Fig. 8 is a section on line 8—8 of Fig. 7, but showing additionally a kelly or grief pipe associated with the mechanism together with wedge slips interposed between the kelly bushing and kelly. It will be understood that these wedge slips are not always used, but they are shown in this view in order to eliminate repetitious illustrations;

Fig. 9 is a section on line 9—9 of Fig. 7 but showing additionally the wedge slips illustrated in Fig. 8;

Fig. 10 is a perspective view of one of the wedge slips;

Fig. 11 is an enlarged fragmentary section on line 11—11 of Fig. 8; and

Fig. 12 is a fragmentary section on line 12—12 of Fig. 11.

While, as mentioned above, the present invention may be embodied with advantage in any type of rotary table and, at least as far as certain features are concerned, with any type of elements carried by the table bushing, for illustrative purposes we have shown the invention as embodied in a particular type of rotary table adapted to have a particular type of driving connection with the work. While such an adaptation or embodiment of the invention is peculiarly effective, it is to be distinctly understood that this showing and description of particularities are not to be considered as limitative on the appended claims, except those which specifically call for these particularities.

The well drilling apparatus shown in Figs. 1 and 2 may be briefly described as including a main frame 10 made up of upper and lower heads 11 and 12, respectively, which are spaced apart by vertical cylinders 13 through which pistons 14 are adapted to be reciprocated or controlled in their reciprocation by fluid admitted under pressure to the cylinders as conventionally indicated at 15. A circular, non-rotatable cross head 16, (of upwardly-opening cup formation) is carried at the upper ends of piston rods 17, and mounted for rotation within the axial bore 18 (Fig. 8) of this head is rotary table 19. The table has a depending annular flange 20 which fits within the upstanding flange of head 16, the flange 20 having internal gear teeth 21 formed thereon. The table is rotated through the medium of a pinion 22 which is in mesh with gear 21 and is slidingly keyed to a vertical drive spindle 23, said spindle being driven, in turn, through bevel gear couple 24, 24a receiving its drive from power shaft 25. Due to the sliding spline connection between spindle 23 and pinion 24, the table may be rotated during vertical reciprocation of the cross-head or when said cross-head is held at any given level.

The drill stem is adapted to pass vertically through the axial bore 19a of the table, means being provided for connecting the table to the stem whereby table rotation imparts like movement to the stem. The drill stem is here indicated as a "grief pipe" or "kelly" 26 which is of square cross-section (Fig. 8) having a vertically extending bore 27 therethrough to accommodate circulating fluid in the usual manner. As stated above, however, it will be understood that all the features of the invention are not confined in their advantageous use by application to work having these particular characteristics.

The master or table bushing here generally indicated at 28 is adapted to be taken within the table bore and may advantageously be of the form shown, though this showing is not to be considered as limitative on the invention, considered in its broader aspects. Bushing 28 is preferably made up of two similar parts 28a, each part including a sleeve portion 29, angular as viewed in plan, and an annular head portion 30. Preferably, though not necessarily, the sleeve portion has external, vertically extending ribs 31 which engage the faces of the table walls which define bore 19a, (the opposed ribs 31a on the two parts meeting, as shown) thus centering the bushing sleeve in said bore, while head portion 30 is taken within the upwardly opening counterbore 32 provided in the table concentrically with bore 19a.

While any suitable rotary drive connection may be made between the table and bushing, as here shown, head portion 30 has radially extending lugs 33 which enter complementary recesses 33a in the table top, said lugs serving to connect said table and bushing drivingly as far as rotation is concerned. Ribs 31 extend downwardly from the head portion to an annular flange 34 provided about the sleeve portion near its lower end and adapted to fit within the table bore. The lower face 35 of the head portion engages the upwardly facing shoulder 36 presented by the table at the junction of its bore and counterbore, the limit of downward movement of the bushing with respect to the table thus being established.

Preferably, head portion 30 is cored out at intervals to provide segmental recesses or cavities 38, a particular recess 38a in one or each of the bushing parts being utilized to contain a locking pin hereinafter described, said pin and its actuating mechanism thus being

housed by the defining walls of said recesses, to obvious advantage.

Before going into the details of the locking mechanism we will describe the illustrated type of table bushing and the means entered in table bushing bore 39 about work 26 and whereby rotation of the table rotationally drives the work. It is desired to emphasize again the fact that the invention, considered in its broader aspects, is not limited to the particular type of bushing-carried, work-encircling means here illustrated. Bushing bore 39 is angular, as viewed in plan, the opposite bore-defining walls 40 inclining inwardly and downwardly towards the axis of the work, and the adjacent opposite walls 41 extending substantially parallel with said axis. Preferably, though not necessarily, walls 41 are cut down and back at their upper ends as at 42 to provide upwardly facing shoulders 43 spaced below but substantially parallel with the upper face of the bushing head.

The kelly bushing generally indicated at 44 is adapted to be dropped into bore 39, this bushing preferably being made up of two similar parts 44ª which, when placed together as in Fig. 6 give an assembly which is angular as viewed in plan and, in effect, is substantially complementary to bore 39. Due to this complementary angularity it will be seen that rotation of the table bushing imparts like movement to the kelly bushing.

The opposite faces 45 of the kelly bushing are adapted to engage walls 41 of the table bushing, while the adjacent, opposite faces 46 incline inwardly and downwardly towards the work axis and engage table bushing faces 40. While the inclination of faces 40 and 46 renders it particularly easy to enter the parts of the kelly bushing within the table bushing bore and about the work, as is obvious, dependence preferably is not had upon engagement of these inclined faces for limiting the downward movement of the kelly bushing through the table bushing. Rather, the upper ends of the kelly bushing have transversely extending flanges 47 which are adapted to come to rest on shoulders 43, the relative dimensions preferably being such that the kelly bushing is supported so its upper face comes substantially flush with the upper face of bushing head 30.

The bore 51 of the assembled kelly bushing is angular as viewed in plan and of a size to take kelly 26 nicely, said kelly being normally capable of movement vertically through said bore, though the complementary angularity of said bore and the kelly is adapted to impart rotational drive of said bushing to said kelly. When hoisting tackle is used the wedges shown in Figs. 8, 9 and 10 are not employed with the kelly bushing but we will now proceed to a description of a situation wherein it may be desirable to utilize these wedges. While rotation of the kelly is accomplished through table rotation, control of the vertical movement of said kelly can be accomplished through usual overhead tackle (not shown). Should there be a failure in this hoisting and lowering mechanism it is highly desirable that the kelly be lifted sufficiently to clear the bit from bottom and then continuously reciprocate it while off bottom until repair has been made, as is well understood by those skilled in the art. Furthermore, in certain situations it is desirable that the table be utilized either to take part of the stem load and feed the bit downwardly or to apply an upward force to the drill stem, such situations having been discussed in the forepart of the specification. Accordingly, it is highly desirable that the kelly bushing be of a type to take work-gripping members whereby the stem may be supported by the table or whereby elevation of the rotary table causes upward movement of the kelly.

For this purpose, the inner faces 53 at the upper ends of the bore defining walls 55 incline inwardly and downwardly from points horizontally offset from kelly 26. Wedge slips 56, having work gripping faces 57, may then be inserted within the tapering recesses 58 defined by the kelly and faces 53, it being apparent that when the table thereafter is hydraulically raised the slips are wedged tightly between the kelly bushings and kelly, faces 57 engaging the kelly in a manner clamping, in effect, said kelly to the table so said kelly is lifted along with said table. The wedge slips preferably are provided with handles 56ª whereby they may be lowered to and lifted from operative position.

Now it is highly desirable that means be provided for preventing accidental upward displacement of the table bushing and kelly bushing with respect to each other and with respect to the table, yet the means holding them down must be of a relatively simple nature though yielding readily to manipulation and adjustment. It must be a sure lock and yet one readily releasable under wilful effort. It must be readily accessible for actuation and repair and yet must be protected. We have provided locking means having all these features. As an additional feature, we utilize a single locking member for holding the table bushing to the table and for holding the kelly bushing or work encircling member to the table bushing. However, it will be understood that considering the invention in its broader aspects, it is not limited to a locking pin having this dual function. At this point it may also be said that while the locking pin is here utilized only as a "hold-down" member, it is also of a nature to impart rotational drive from one element to another. Preferably, though not necessarily, each part of the table bushing has an independent locking pin, but since these pins and their actuating

means may be alike, we will describe but one in detail.

Considering the locking member as a single element adapted to lock both the table and kelly bushing, it will be hereinafter made apparent that, considering the table, table-bushing and kelly bushing as three nested elements, the locking mechanism is carried by the intemediate element (the table bushing) and is adapted to be projected from either or both sides thereof into locking engagement with the elements nested therewith.

In Figs. 4, 8, 11 and 12, one of the locking mechanisms is shown housed within one of the bushing recesses or cavities 38ª, this recess being vertically defined by top wall 60 and bottom wall 61, respectively, of head 30 and horizontally defined by the vertical head walls 62 and 63. A horizontal locking pin 64 has bearing in walls 62 and 63, said walls having apertures 65 and 66, respectively, to take the pin. Aperture 65 opens to bushing bore 39, and aperture 66 is in horizontal alinement with a socket 67 provided in table 16 and opening to counterbore 32. Pin 64 is of such length that when it is moved to the position of Fig. 11 its ends 68 and 69 project beyond the exposed faces of walls 62 and 63, respectively.

Pin 64 is adapted to be reciprocated horizontally through the medium of a vertical actuating shaft 70 which has gear teeth 71 meshing with rack teeth 72 provided on one side of pin 64. Shaft 70 has bearing in walls 60 and 61 at 73 and 74, respectively, being held from accidental upward displacement by means of a keeper ring 75 screwed to top wall 60 and overlying flange 76 on the shaft. The shaft has a wrench-taking head 77 (or other suitable tool-taking formation) which head projects above the bushing top or is otherwise made accessible from outside recess 38ª. Thus, the means for actuating the locking pin is fully accessible to the workmen and yet the mechanism is housed so as to be well protected. It will be apparent that when shaft 70 is rotated through the application of a suitable tool, pin 64 is reciprocated horizontally.

The locking means is operated as follows:

Assuming that the table bushing and kelly bushing are to be assembled with the table, shafts 70 are first actuated to move pins 64 to the position of Fig. 4, their ends 69 then being flush with or below the outer faces of walls 63, while their inner ends 68 project well into bore 39. The table bushing is then dropped into place within the table bore and shafts 70 are actuated to retract pins 64 until their ends 68 are at least flush with the outer faces of walls 62, sockets 67 being of a length to allow this retractive movement. The kelly bushing is then dropped into the table bushing bore 39, and when flanges 47 come to rest on shoulders 43, sockets 78 (Fig. 6) in the side faces of the kelly bushings are in alinement with the locking pins, shafts 70 are then operated to project the locking pins so their ends 68 enter sockets 78, said pins then immediately overlying the upwardly facing shoulders 79 presented by lugs 80 in said sockets and thus prevent subsequent upward movement of the kelly bushing with respect to the table bushing. However, the ends of pins 64 engage the vertically extending shoulders 81, presented by lugs 80, before the pins have been moved sufficiently to clear ends 69 from sockets 67, it following that when the pins are moved to the position of Figs. 8 or 11 the pins each project at opposite sides of the table bushing into locking engagement with the table and the kelly bushing.

It will thus be seen that lugs 80 (and hence, in effect, the kelly bushing) provide limiting stops for the pins to prevent accidental release of the table bushing from the table during the operation of locking the kelly bushing to the table bushing, and it will be seen that before the table bushing can be removed from the table, it is first necessary to remove the kelly bushing. To accomplish such removal pins 64 are first moved to the left, as viewed in Fig. 11, until they clear the kelly bushing, said bushing is withdrawn from bore 39, and then the pins are moved to the right, as viewed in Fig. 11, until their ends 69 clear socket 67, whereupon the table bushing may be lifted clear of the table.

It will be understood the drawings and description are to be considered merely as illustrative of and not restrictive on the broader claims appended hereto, for various changes in design, structure and arrangement may be made without departing from the spirit and scope of said claims.

We claim:

1. A drive bushing for rotary tables, said bushing having a vertical opening therethrough to take a square drill stem, a portion of said opening near its lower end being shaped to engage opposite sides of the square drill stem, and a downwardly pointing wedge slip entered between said stem and the bushing at a point above said portion.

2. A drive bushing for rotary tables, embodying a body portion having a vertically extending opening therethrough, said opening being of polygonal cross section to substantially fit a polygonal drill stem, said bushing being cut back at one side of said opening to form a face inclining inwardly and downwardly toward the work, and a downwardly pointing wedge slip entered in the space between the work and said inclined face.

3. A drive bushing for rotary tables, embodying a body portion having a vertically extending opening therethrough, said opening being of polygonal cross section to sub-

stantially fit a polygonal drill stem, said bushing being cut back at opposite sides of said opening to form at each of said opposite sides a face inclining inwardly and downwardly toward the work, and a pair of downwardly pointing wedge slips entered one in each of the spaces between the work and said inclined faces.

In witness that we claim the foregoing we have hereunto subscribed our names this 25th day of January, 1928.

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ALBERT L. STONE.