April 21, 1959 L. B. GALLATIN 2,883,157

ANGLE DRILLING APPARATUS

Filed Nov. 5, 1956 4 Sheets-Sheet 1

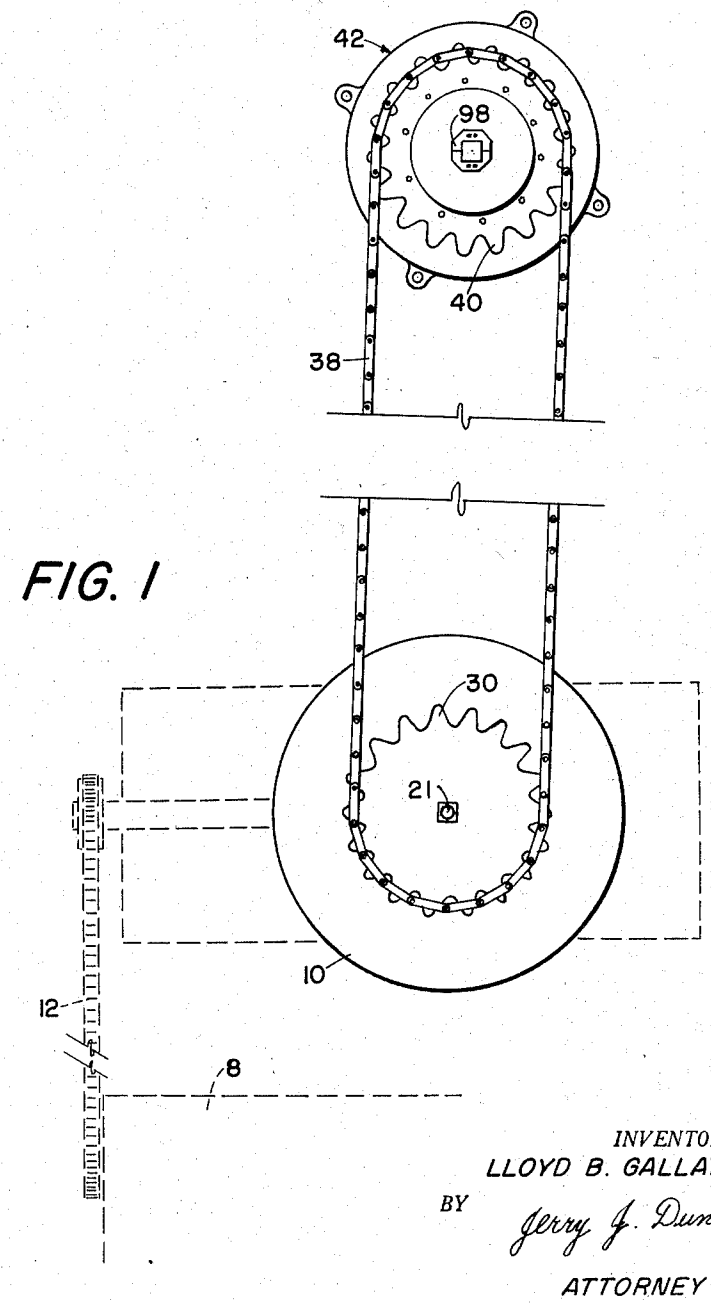


FIG. 1

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ANGLE DRILLING APPARATUS

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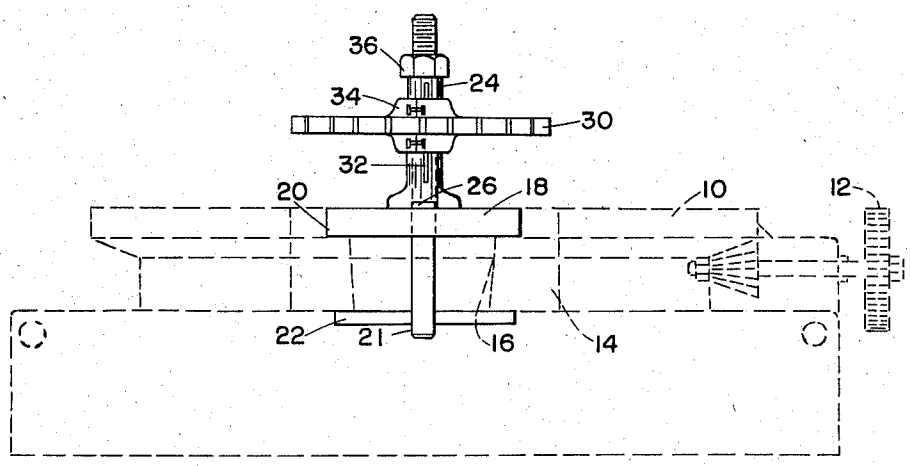


FIG. 2

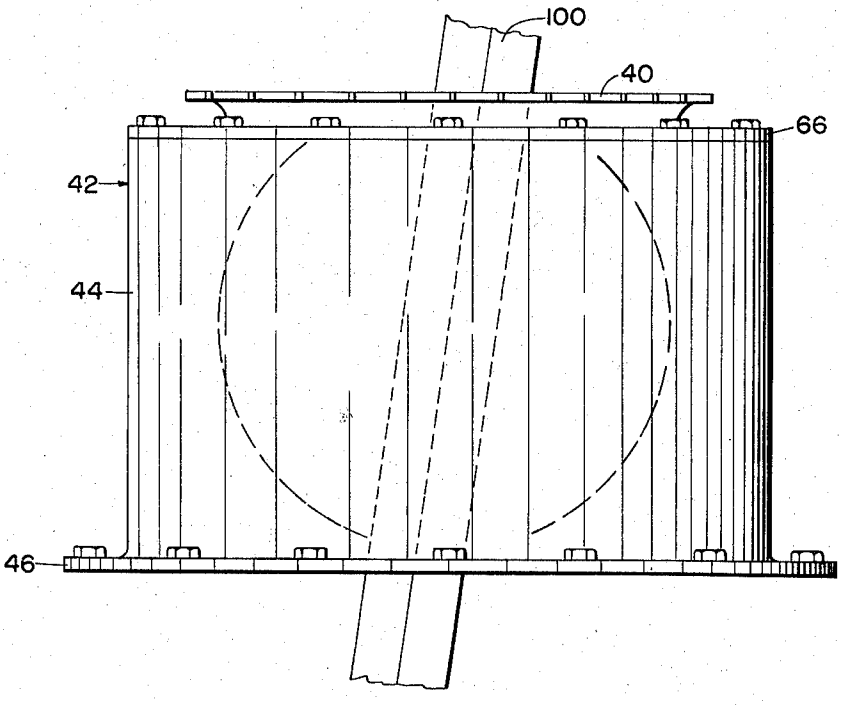


FIG. 3

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ANGLE DRILLING APPARATUS

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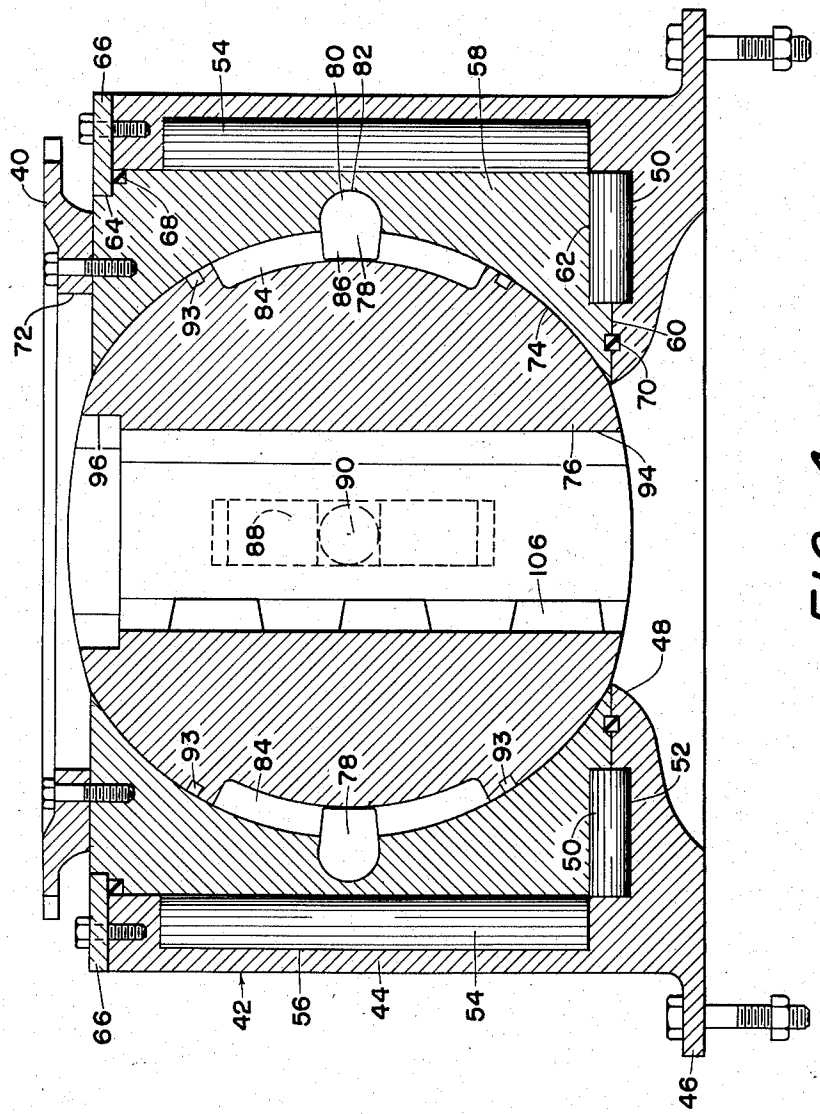


FIG. 4

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ANGLE DRILLING APPARATUS

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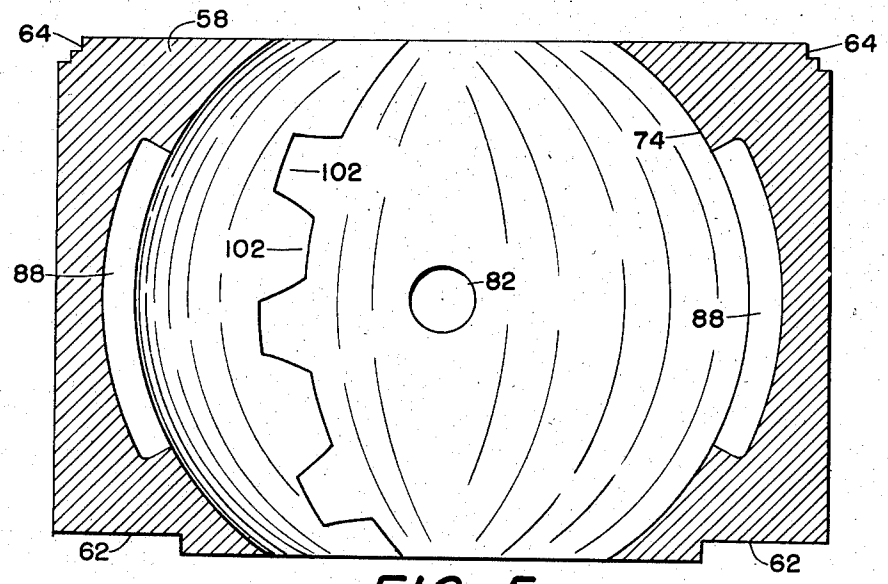


FIG. 5

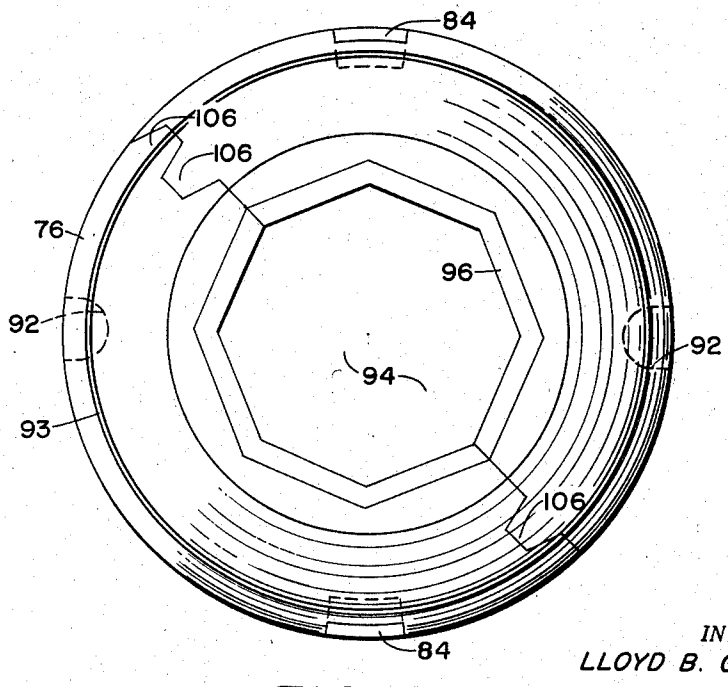


FIG. 6

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2,883,157

ANGLE DRILLING APPARATUS

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Application November 5, 1956, Serial No. 620,226

5 Claims. (Cl. 255—23)

This invention relates generally to improvements in the art of drilling wells, cores and the like by the rotary drilling method, and more particularly, but not by way of limitation, to an improved apparatus for drilling rat holes on a well drilling location.

As it is well known in the art, the rotary method of drilling wells involves the use of a drill bit on the lower end of a string of drill pipe. A kelly, which is square in cross-section, is secured to the upper end of the drill string and telescopes through a rotary table for rotating the drill string and operating the bit. As the drill bit makes progress through the various subsurface formations, the kelly moves downwardly through the rotary table. When the kelly has moved substantially all the way through the table, the kelly and the drill string are raised by a hoisting apparatus extending down from the center of the drilling rig until the uppermost joint of drill pipe protrudes through the rotary table. The upper joint of the drill pipe is then suitably secured in the rotary table and the kelly is detached from the drill string for the addition of another joint of drill pipe to the string. While the new joint of drill pipe is being added to the drill string, the kelly is ordinarily swung to one side of the rig and inserted in a separate shallow bore positioned adjacent the well bore. This shallow bore is ordinarily known as a rat hole and is provided to hold the kelly out of the way of personnel on the rig while additional joints of drill pipe are added to the drill string. The rat hole extends at an angle, or, in other words, is slanted, to facilitate the insertion and withdrawal of the kelly by the usual hoisting apparatus. It will be apparent that the drilling of such a slanted bore presents problems not encountered when the usual vertical well bore is being formed.

Several methods have been devised for drilling such rat holes, but each previous method has been time consuming, and the apparatus expensive. It is preferred that the usual power unit or draw works utilized for drilling the well bore also be utilized for drilling the rat hole. Heretofore, however, the driving connection between the draw works (or the usual rotary table) and the rat hole drilling apparatus has ordinarily been extended at an angle to the vertical to provide the slanting rat hole. Such a driving connection is difficult to maintain in the proper position and creates excessive wear on the chain or other driving mechanism. In those previous apparatuses wherein a chain driving mechanism is retained horizontally to provide a straight drive from the rotary table, there has been inadequate connection of the rat hole drilling mechanism to the kelly. It has also been proposed to drill the rat hole by a separate power unit, or manually, however, these last methods are extremely expensive and/or time consuming.

The present invention contemplates a rat hole drilling apparatus which may be driven from the usual rotary table by means of an endless chain, wherein the chain may be retained in a horizontal position during the drilling operation to provide an efficient transfer of energy

from the rotary table to the rat hole drilling apparatus. The present apparatus contemplates a novel swivel type construction, whereby a kelly may be pivoted in any direction from the vertical through a substantial number of degrees, and a rat hole may be drilled at substantially any desired angle. The swivel type construction of the present apparatus provides a positive connection from the power source to the kelly, whereby the kelly is retained at an angle and will be positively driven without slippage.

An important object of this invention is to provide a rat hole drilling apparatus which utilizes the kelly and power unit ordinarily used in drilling an oil or gas well by the rotary method.

Another object of this invention is to rotate a kelly by the usual rotary table while the kelly is disposed at an angle to the vertical.

Another object of this invention is to provide a rat hole drilling apparatus powered from the usual rotary table by use of an endless chain, wherein the chain may be maintained horizontally and driven in a straight line during operation of the rat hole drilling apparatus.

A further object of this invention is to provide a rat hole drilling apparatus utilizing a novel swivel type driving connection between the kelly and the power means.

Another object of this invention is to generally facilitate the drilling of rat holes, whereby rat holes may be drilled faster and more economically than by present methods.

A still further object of this invention is to provide a rat hole drilling apparatus which may be economically manufactured.

Other objects and advantages of the invention will be evident from the following detailed description, when read in conjunction with the accompanying drawings, which illustrate my invention.

In the drawings:

Figure 1 is a plan view of a rotary table, a portion of the usual draw works, and my novel rat hole drilling apparatus connected to the rotary table.

Figure 2 is an elevational view of a rotary table illustrating the sprocket arrangement utilized with the table for driving my rat hole drilling apparatus.

Figure 3 is an elevational view of my rat hole drilling apparatus, with a kelly extending therethrough.

Figure 4 is a vertical sectional view through the rat hole drilling apparatus of this invention.

Figure 5 is a vertical sectional view through the outer bushing of the present apparatus, wherein the section is taken at right angles to the section of Fig. 4.

Figure 6 is a plan view of the inner, ball-shaped bushing which receives the kelly.

Referring to the drawings in detail, and particularly Fig. 1, reference character **8** designates the usual draw works employed by a rotary drilling apparatus. The draw works **8** is utilized to drive a rotary table **10** through a suitable chain drive **12**. Normally, the rotary table **10** is positioned at the center of the drilling rig (not shown), whereby a kelly extended through the rotary table will drill a substantially vertical well bore, and the insertion and withdrawal of the kelly through the rotary table **10** may be easily accomplished by a suitable hoisting mechanism (not shown) extending from the top of the drilling rig.

As shown by dotted lines in Fig. 2, the rotary table **10** contains a master bushing **14** having a bore **16** extending vertically therethrough. The bore **16** normally contains the Kelly slips and the kelly for turning the kelly upon rotation of the table **10**. When using the present invention, a plate **18** is inserted in a counter-bore **20** in the upper end of the master bushing **14**. The plate **18** is suitably shaped to provide rotation of the plate **18** upon

rotation of the bushing 14. A rod 21 extends vertically through the plate 18 and the master bushing 14. A cross-bar 22 extends transversely through the lower end portion of the rod 21 and is of a length to contact the bottom end of the bushing 14 for purposes which will be hereinafter set forth. A tubular sleeve 24 is telescoped over the rod 21 above the plate 18, and the sleeve 24 is suitably keyed to the plate 18 by a key and key-way 26 to provide rotation of the sleeve 24 upon rotation of the plate 18. A sprocket 30 is in turn telescoped over the sleeve 24 and is keyed to the sleeve by means of a key 32 and a complementary key-way in the sprocket 30, whereby the sprocket 30 will be rotated upon rotation of the sleeve 24. It is preferred that the hub 34 of the sprocket 30 be split and bolted together, whereby the sprocket 30 may be moved to various vertical positions on the sleeve 24. The key 32 extends for a substantial length along the sleeve 24 to permit positioning of the sprocket 30 at the various heights. The upper end of the rod 21 is threaded to receive a nut 36, whereby the cross-bar 22 will be brought into tight engagement with the bottom of the master bushing 14 when the nut 36 is tightened into contact with the upper end of the sleeve 24.

The sprocket 30 is provided to receive an endless chain 38 as shown in Fig. 1. The chain 38 also extends around a complementary sprocket 40 of my novel rat hole drilling apparatus, which is generally indicated at 42, whereby the apparatus 42 will be driven upon rotation of the rotary table 10.

As illustrated in Fig. 1, the apparatus 42 is positioned in spaced relation to the rotary table 10, whereby the apparatus 42 will not be positioned in the central portion of the drilling rig. Ordinarily, the apparatus 42 will be positioned in front of, and slightly to the right of the rotary table 10 when viewed as in Fig. 1. Thus, when a kelly is swung over for insertion in, or withdrawal from, the apparatus 42, it will extend at an angle, and the resulting rat hole (not shown) must necessarily be drilled at an angle to the vertical, or, in other words, in a slanting fashion.

As shown in Figs. 3 and 4, the apparatus 42 comprises a cylindrically shaped housing 44 having a circumferential flange 46 around the lower end thereof for securing the apparatus to a stationary supporting means (not shown), such as a rig floor. The upper end of the housing 44 (see Fig. 4) is open, and the lower end of the housing has an aperture 48 in the central portion thereof for purposes which will be hereinafter set forth. An annular shaped thrust bearing unit 50 is positioned in the bottom wall of the housing 44 in a complementary annular groove 52. The bearing unit 50 preferably comprises a series of rollers placed in side by side relation and retained in suitable races, however, any suitable type of thrust bearing unit will suffice. Another bearing unit 54 is positioned around the inner periphery of the housing 44 and is preferably anchored in a complementary recess 56.

A tubular bushing 58, sometimes referred to herein as the driving bushing, is rotatably disposed in the housing 44 in contact with the bearing units 50 and 54. The lower end 60 of the bushing 58 is provided with an annular groove 62 around the outer edge thereof to receive the upper portion of the bearing unit 50, whereby any thrust imposed on the bushing 58 will be transmitted through the bearing unit 50 to the lower end of the housing 44. The upper end of the bushing 58 is provided with an annular groove 64 around the outer edge thereof to receive the inner edge of a retaining ring 66. The ring 66 is bolted to the top of the housing 44 and is provided to retain the bushing 58 in operating position in the housing. A sealing ring 68 is disposed in a complementary groove in the upper end of the bushing 58 immediately below the retaining ring 66 to minimize the leakage of grease out of the upper end of the housing 44. Another sealing ring 70 is disposed in complementary grooves in the lower end of the bushing 58 and the bottom of the housing 44 for similar purposes.

The sprocket 40, previously described, is bolted to the upper end of the bushing 58 to receive the chain 38 and rotate the bushing 58 upon operation of the rotary table 10. An enlarged bore 72 extends through the center of the sprocket 40. The diameter of the bore 72 should be at least as large as the diameter of the bore 48 in the lower end of the housing 44.

The inner periphery 74 of the bushing 58 is shaped in the form of a partial sphere to slidingly receive a similarly shaped bushing 76. The bushing 76 is sometimes referred to herein as the driven bushing. Two lugs 78 are secured in the inner periphery 74 of the driving bushing 58 in diametrically opposed relation to make a driving connection with the driven bushing 76. The outer end portion 80 of each lug 78 is ball-shaped to slidingly fit in a complementary recess or indentation 82 in the bushing 58. The lugs 78 are positioned at substantially the central portion, in height, of the bushing 58 and project inwardly into grooves 84 in the inner bushing 76. Each groove 84 extends vertically along the central portion of the bushing 76 and is of a length approximating half of the length of the outer bushing 58. Also, each groove 84 is square-shaped in cross-section, and the inner ends 86 of the lugs 78 are similarly shaped to provide a sliding fit of the lugs 78 in the grooves 84, yet provide maximum contact between the sides of the lugs 78 and the sides of the grooves 84 to impart rotation to the inner bushing 76 upon rotation of the outer bushing 58.

As shown in Fig. 5 grooves 88 are formed in the inner periphery 74 of the bushing 58 in ninety degree spaced relation to the indentations 82 and lugs 78. The grooves 88 extend vertically and are of substantially the same length as the grooves 84 in the inner bushing 76. Also, the grooves 88 are square in cross-section to receive the inner ends of lugs 90 (Fig. 4) secured in the outer periphery of the inner bushing 76. The lugs 90 are spaced ninety degrees from the grooves 84, and are shaped in the same manner as the lugs 78 to provide sliding contact with the grooves 88. Spherical shaped indentations 92 (see Fig. 6) are formed in the outer periphery of the inner bushing 76 to receive the inner, rounded ends of the lugs 90 and provide a slightly swivel connection of the lugs 90 to the bushing 76. Grease or lubricating grooves 93 are formed circumferentially in the outer periphery of the bushing 76 above and below the grooves 84. Also, a bore 94 extends through the center of the bushing 76 along the normally vertical axis of the bushing.

In summarizing the connection of the inner bushing 76 to the outer bushing 58, it will be observed that the inner bushing 76 may be pivoted either to the left or to the right when viewed as in Fig. 4. In either event, the grooves 84 will move over the inner ends 86 of the lugs 78 until the lugs 78 contact the ends of the grooves 84. Simultaneously, the oppositely extending lugs 90 will pivot in their indentations 92 in the bushing 76 to permit unrestricted movement of the driven bushing. It will also be apparent that the inner bushing 76 may be pivoted or turned in the opposite direction, whereupon the lugs 90 will slide through the complementary slots 88, and the lugs 78 will pivot in the indentations 82. Thus, the inner bushing 76 may be pivoted about any axis extending horizontally through the bushing 76, yet the bushing 76 will be rotated upon rotation of the outer bushing 58, and the bushing 76 will be rotated about the axis of the bore 94, regardless of the pivoted position of the bushing 76 in the bushing 58.

The bore 94 terminates at its upper end in a slightly enlarged counter-bore 96. Each of the bores 94 and 96 is octagonal in cross-section to receive the usual Kelly slips 98 in the manner indicated in Fig. 1. The Kelly slips 98 may be freely inserted in the bore 94, and the upper ends of the slips will be received in the counter-bore 96, whereby the kelly 100 (Fig. 3) may be inserted

through the bushing **76** and will be drivingly connected to the bushing **76**, yet the kelly **100** may slide through the Kelly slips **98** during a drilling operation. The bore **94** is of sufficient diameter to permit movement of a drill bit (not shown) therethrough when the kelly is inserted in or withdrawn from the apparatus during drilling of the rat hole.

To facilitate manufacture and assembly of the bushings **58** and **76**, each of the bushings is constructed in two segments. As most clearly shown in Fig. 5, the segments of the outer bushing **58** are interconnected by mating teeth **102**, with the teeth **102** extending substantially horizontally. It will be understood that teeth **102** are formed on each mating edge of each of the bushing segments to provide a close fit of the bushing segments in the housing **44**. The two segments of the outer bushing **58** are formed opposite hand, with each segment having a groove **88** and an indentation **82** therein. The opposed segments of the inner bushing **76** are also interconnected by horizontally extending teeth **106** as shown in Fig. 6, and each segment has a groove **84** and an indentation **92** in the outer surface thereof.

Operation

In assembling the rat hole drilling apparatus **42**, a suitable lubricant is placed in the lubricating grooves **93**, and the segments of the inner bushing **76** are fitted together as illustrated in Fig. 6. The lugs **90** are then inserted in the indentations **92**, the lugs **78** are inserted in the indentations **82**, and the segments of the outer bushing **58** are fitted over the bushing **76** as illustrated in Fig. 4. As shown, and as previously described, the bushing **58** is positioned with respect to the inner bushing **76** such that the lugs **78** extend into the grooves **84** of the inner bushing **76**, and the lugs **90** extend into the grooves **88** of the outer bushing **58**. The assembled bushings are then inserted in the housing **44** on the bearing unit **50** and in the bearing unit **54**. Whereupon, the sprocket **40** is bolted to the upper end of the bushing **58**, and the retaining ring **66** is bolted to the upper end of the housing **44**. If desired, the sprocket **40** may be formed in segments in the same manner as the outer bushing **58**. The Kelly slips **98** are removed from the rotary table **10**, and the sprocket **30** is secured in the master bushing **14** of the rotary table in the manner illustrated in Fig. 2, whereupon the chain **38** may be placed over the sprockets **30** and **40**. The sprocket **30** is adjusted on the sleeve **24** to a height equal to the sprocket **40**, whereby the chain **38** will extend substantially horizontally.

When it is desired to drill the rat hole, the kelly **100**, having a drill bit attached to the lower end thereof is inserted through the bore **94** of the inner bushing **76** into contact with the earth. The Kelly slips **98** are then inserted in the bore **94** around the kelly **100** to provide a driving connection between the kelly and the inner bushing **76**. The kelly may be pivoted to the desired direction as illustrated in Fig. 3.

The rotary table **10** is then placed in operation to rotate the master bushing **14** and the sprocket **30**. The chain **38** will provide a simultaneous rotation of the sprocket **40** and the driving bushing **58** of the rat hole drilling apparatus **42**. The inner ends **86** of the lugs **78** will engage the side walls of the grooves **84**, and the outer ends of the lugs **90** will engage the side walls of the respective grooves **88** to provide rotation of the driven bushing **76** upon rotation of the driving bushing **58**. Also, of course, the rotation of the driven bushing **76** is transmitted through the Kelly slips **98** to the kelly **100**. Thus, the kelly **100** will rotated about its longitudinal axis to drive the drill bit and drill the necessary rat hole at the desired angle.

If desired, drill pipe may be added to the kelly **100** to extend the rat hole to any desired depth. When adding drill pipe, the Kelly slips **98** are removed from the inner bushing **76** to permit withdrawal of the kelly **100** and the drill bit through the bore **94**. Upon reinsertion of the kelly, drill pipe and drill bit through the bore **94**, the Kelly slips **98** may be reinserted in the bore **94** to grip the kelly for further drilling operations.

When the rat hole has been drilled to the desired depth, the kelly, drill pipe and drill bit are removed and the sprocket **30**, along with its connecting assembly is removed from the master bushing **14** of the rotary table **10**. The drilling of the usual bore directly below the rotary table **10** can then be carried out in the usual manner. The rat hole drilling apparatus **42** may be removed from above the rat hole if desired, or the mechanism may be left in place over the rat hole to facilitate support of the kelly **100** when the kelly is inserted in the rat hole for the addition of drill pipe to the main drill string as previously described.

From the foregoing it will be apparent that the present invention provides a rat hole drilling mechanism whereby a kelly may be rotated by the usual rotary table while the kelly is disposed at an angle to the vertical. The present drilling mechanism is actuated by the usual drilling unit to provide an economical drilling operation. The chain used for connecting the rat hole drilling apparatus to the rotary table is retained horizontally and driven in a straight line to provide an efficient power transfer to the rat hole drilling mechanism. The present rat hole drilling mechanism includes a novel swivel type construction whereby a positive connection will be made with the kelly when the kelly is extended at an angle during the drilling of a rat hole. It will also be apparent that the present apparatus is simple in construction and may be economically manufactured.

Although the present description has been devoted to use of the drilling apparatus for drilling rat holes, it will be apparent that the invention may be readily adapted for other uses.

Changes may be made in the combination and arrangement of parts or elements as shown in the drawings and described in the specification without departing from the spirit and scope of the invention as defined in the following claims.

I claim:

1. In a drilling apparatus, a driving bushing having a bore therethrough with said bore having the shape of a partial sphere, a driven bushing disposed in said bore and having an outer surface conforming to the shape of said bore for turning in said bore in any direction, alternately arranged lugs and vertical grooves spaced ninety degrees apart around the outer periphery of said driven bushing, mating lugs and grooves in the walls of said bore to provide rotation of said driven bushing upon rotation of said driving bushing and allowing pivoting of said driven bushing with respect to said driving bushing in the direction of any said grooves, the end of each lug extending into a vertical groove being squared, and each groove being similarly shaped in cross-section, the opposite end of each lug being rounded and slidingly disposed in a rounded indentation in the respective bushing.

2. A rat hole drilling apparatus for use with the rotary table and kelly of a well drilling apparatus, comprising a stationary housing, a driving bushing rotatably supported in said housing to rotate about substantially a vertical axis, means drivingly connecting said driving bushing to the rotary table for rotating said driving bushing upon rotation of the rotary table, said driving bushing being hollow with its inner periphery in the form of a partial sphere, a driven bushing in said driving bushing corresponding in size and shape to said inner periphery to slidingly fit in said driving bushing, said driven bushing having a bore through the center thereof for slidingly receiving the kelly, and cooperating lugs and vertical grooves provided alternately around the outer periphery of said driven bushing and the inner periphery of said driving bushing, with the lugs in said driven bushing extending into sliding engagement with the walls of

the grooves in said driving bushing and the lugs in said driving bushing extending into sliding engagement with the walls of the grooves in said driven bushing, each set of cooperating lugs and grooves being spaced ninety degrees from the adjacent sets of cooperating lugs and grooves.

3. Apparatus as defined in claim 2 characterized further in that said lugs are rounded on one end and squared on the opposite end, with the rounded ends being disposed in correspondingly shaped indentations in the driven and driving bushings, and said grooves are substantially square in cross-section to slidingly receive the squared ends of the lugs.

4. Apparatus as defined in claim 2 characterized further in that said lugs and grooves comprise two lugs and two vertical grooves alternately and equally spaced around the outer periphery of said driven bushing, and mating lugs and grooves in the inner periphery of said driving bushing, whereby said driven bushing may be

pivoted about any axis extending horizontally through the center thereof.

5. Apparatus as defined in claim 2 characterized further in that said means comprises a sprocket secured to said driving bushing in substantially a horizontal plane, another sprocket similarly secured to the rotary table at substantially the same level, and an endless chain engaging said sprockets.

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