

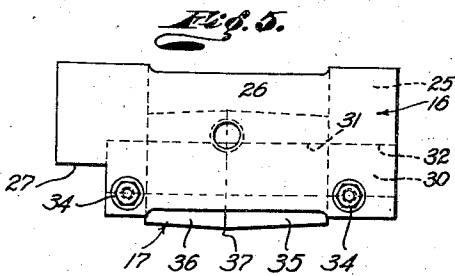
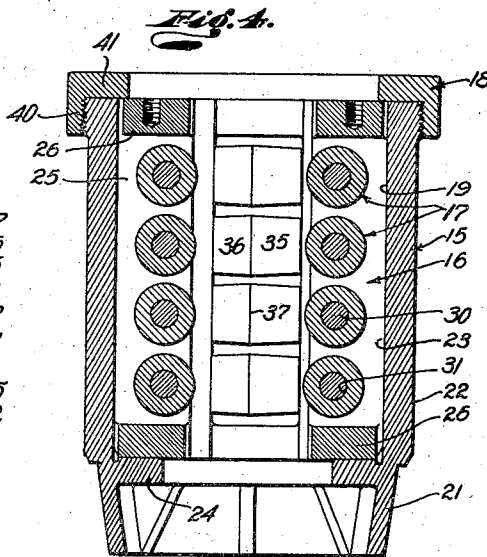
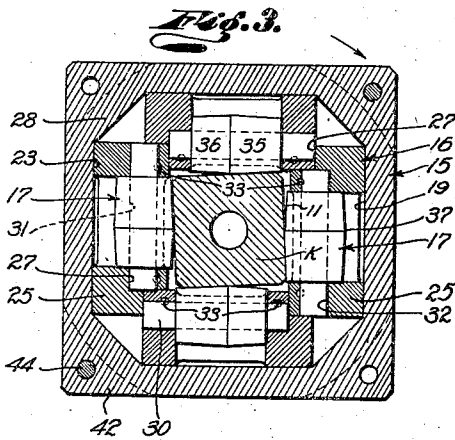
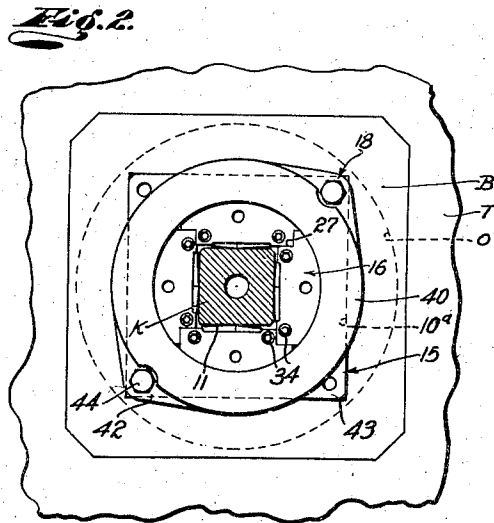
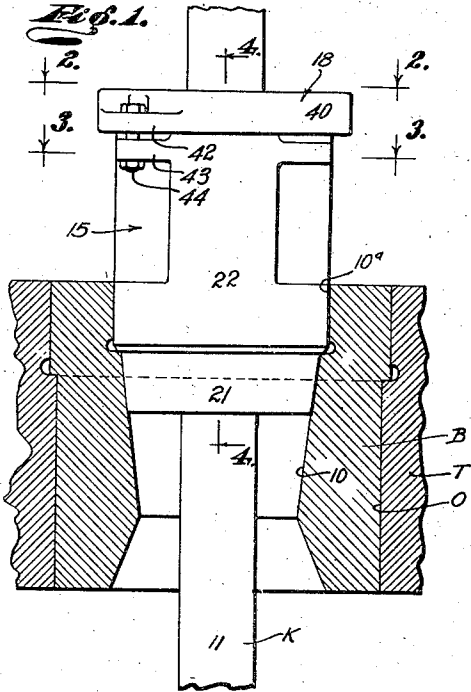
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KELLY BUSHING

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KELLY BUSHING

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4 Claims. (Cl. 255—23)

This invention relates to well drilling apparatus and relates more particularly to a drive bushing or Kelly bushing for use in the rotary table of a well drilling rig. A general object of this invention is to provide a practical, effective and improved roller type Kelly bushing.

In the rotary method of well drilling a drive bushing or Kelly bushing is arranged in the rotary table to cooperate with the grip stem or kelly of the drilling string for the purpose of imparting rotation to the string. The engagement between the Kelly bushing and the kelly is such that the drill stem may be moved vertically while the driving or rotative engagement is maintained between the bushing and the kelly. Kelly bushings embodying rollers for contacting the kelly have been introduced to lessen the wear and friction between the kelly and the bushing parts and to assure smoother movement of the drilling string and more positive control of the drilling string.

Grip stems or kellys of the type now in general use are substantially square in transverse cross section, having four principal side surfaces disposed at substantially 90° to one another. The Kelly bushings that have been introduced employing rollers have sets or series of cylindrical rollers arranged to define a square opening for receiving the kelly. The rollers are of necessity related to receive the kelly with suitable clearance and when rotation of the bushing is initiated each cylindrical roller moves into driving contact with a flat face of the kelly. Due to the essential clearance just referred to and the cylindrical configuration of the rollers, each roller, of the previously introduced, Kelly bushings has only line contact or very limited contact with a surface of the kelly. When wearing of the kelly and rollers occurs this action is more pronounced and it has been observed that the rollers each have a very limited surface portion at one end only in contact with the kelly when the bushing is driving or turning the string. The very limited engagement of the rollers with the kelly results in the improper distribution of the driving forces and concentration of the wear on very limited areas of the kelly and the bushing rollers.

Another object of this invention is to provide a Kelly bushing embodying rollers for cooperating with the kelly which rollers have extensive portions of their surfaces in full driving contact with the faces of the kelly thereby assuring a more uniform distribution of the driving forces

and appreciably lessening the wear on the kelly and the rollers.

Another object of this invention is to provide an improved Kelly bushing embodying anti-friction rollers shaped and positioned to have extensive driving or force transmitting engagement with the surfaces of the kelly.

Another object of this invention is to provide a Kelly bushing embodying rollers having pitched or tapered surfaces that come into full even force transmitting engagement with the kelly when the play or clearance is taken up at the initiation of movement of the rotary table, thereby reducing wear and friction and assuring a better distribution of the driving forces.

Another object of this invention is to provide a Kelly bushing of the character mentioned in which the engagement between the rollers and the kelly cannot produce longitudinal grooves or limited areas of excessive wear on the kelly.

Another object of this invention is to provide an improved Kelly bushing of the character mentioned in which the rollers are supported for independent rotation in a novel and particularly dependable manner and may be easily and inexpensively replaced when worn.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of my invention, throughout which description reference is made to the accompanying drawing, in which:

Fig. 1 is a side elevation of the improved rotary table bushing of the present invention illustrating it in the operative position in the master bushing of a rotary table. Fig. 2 is a top or plan view of the assembly being a view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is a transverse detailed sectional view taken as indicated by line 3—3 on Fig. 1. Fig. 4 is an enlarged vertical detailed sectional view taken as indicated by line 4—4 on Fig. 1 and Fig. 5 is an enlarged top or plan view of one of the cages and its rollers removed from the body.

The drive bushing or Kelly bushing of the present invention is intended for use in the rotary table of a well drilling rig for engaging and driving the grip stem or kelly of the drilling string. In the following detailed disclosure I will describe a typical preferred form of the invention intended for arrangement in a typical master bushing of a rotary table and as employed in connection with a typical grip stem or kelly. It is to be understood that the invention is not to be con-

strued as limited or restricted to the specific form or application about to be described.

Figs. 1 and 2 of the drawing illustrate a portion of a typical rotary table T having the usual central opening O. A master bushing B is arranged in the opening O and is seated therein to turn with the rotary table T. In accordance with the usual practice the bushing B has a central longitudinal opening 10. The principal or major portion of the opening 10 is round in horizontal section and is downwardly and inwardly tapered or reduced in diameter. The upper portion 10^a of the opening 10 is polygonal in horizontal section. In the particular case illustrated the upper portion 10^a of the bushing opening 10 is substantially square in horizontal cross section having four flat surfaces 11 disposed at substantially 90° to one another. The kelly K may be considered as connected with the upper end of a rotary well drilling string and as shown in the drawing extends centrally through the vertical opening 10 of the bushing B.

The improved Kelly bushing of the present invention includes, generally, a body 15 to be arranged in the upper portion 10^a of the bushing opening 10, a plurality of cages 16 in the body 15, rotatable members or rollers 17 mounted in the cages 16 to cooperate with the kelly K and means 18 for retaining the cages 16 in the body 15.

The bushing body 15 is intended to be supported in the upper portion 10^a of the bushing opening 10 to rotate with the bushing B and the table T. The body 15 is provided to house or carry the cages 16 and is hollow or tubular having a central longitudinal opening 19. The body 15 is shaped to properly cooperate with the opening 10. The body 15 has a tapered lower portion 21 of round horizontal cross section to fit the opening 10 and a main body portion 22 of polygonal or square horizontal cross section to fit the upper portion 10^a of the opening 10. The body 15 is preferably comparatively long to accommodate large cages 16 and its main portion 22 may project from the upper surface of the bushing B as illustrated in the drawing. The opening 19 in the body 15 is provided to pass the kelly K and to house the cages 16. The opening 19 extends vertically through the body 15 from one end to the other and is such that the roller carrying cages 16 may be passed into it from its upper end. The opening 19 of the body 15 is preferably polygonal having four principal flat vertical walls 23 to have driving contact with the cages 16. An inwardly projecting stop or supporting flange 24 is provided on the body 15 to project into the opening 19 adjacent its lower end.

The cages 16 are provided to mount or carry the rollers 17 within the body 15. In the embodiment of the invention illustrated in the drawing there are four like cages 16 arranged within the body 15 to bear against its internal walls 23. The cages 16 are substantially rectangular in configuration having spaced vertical sides 25 and horizontal ends 26 extending between and connecting the sides 25. The lower ends 26 of the cages 16 are adapted to rest or bear on the flange 24. The cages 16 are proportioned so that their upper ends 26 have their upper surfaces substantially flush with the upper end of the body 15 when the cages are resting on the flange 24. In accordance with the invention the four cages 16 nest or mesh with one another to be held in their proper positions against the body walls 23. A flat sided vertical recess 27 is provided in an inner corner portion of each cage 16 to receive the

corner portion of an adjacent cage. The cages 16 having their corner portions cooperating with the recesses 27 of adjacent cages form a substantially rigid interlocked assembly which bears outwardly against the body walls 23. The bushing body 15 may have diagonal corner portions 28 in the corners of the body opening 19 to aid in positioning the cages 16 and to strengthen the general structure.

The rotatable members or rollers 17 are provided on the cages 16 to engage the surfaces 11 of the kelly K. The rollers 17 are horizontally disposed in the cages 16 and are arranged to project from their inner sides to contact the kelly K. In accordance with the invention there is a plurality or series of rollers 17 provided on each cage 16. The rollers 17 are spaced apart vertically and are in vertical alignment. In practice the rollers 17 may be equally spaced apart vertically. However, it may be preferred to space the rollers 17 unequally to prevent ridging or grooving of the kelly K. The several rollers 17 are preferably identical and preferably have flat normal ends. The rollers 17 are arranged in the cages 16 to have their ends at or adjacent the inner surfaces of the cage sides 25.

The rollers 17 are preferably carried by shafts or pins 30. Each roller 17 is provided with a central longitudinal opening 31 extending through it from one end to the other. The supporting pins 30 are arranged through the openings 31 to project beyond the opposite ends of the rollers. In accordance with the invention the pins 30 are rigid with the rollers 17. In practice the rollers 17 may be shrunk on the pins 30 to be rigidly secured to the pins. The projecting end portions of the pins 30 are rotatably received in openings 32 in the sides 25 of the cages 16. The openings 32 are horizontally aligned whereby the rollers 17 are supported for rotation about horizontal axes. The roller carrying pins 30 are locked or held against longitudinal movement. The end faces of the adjacent cages 16 partially close or extend across the outer ends of the openings 32 to definitely hold the pins 30 against longitudinal movement. Fig. 3 of the drawing illustrates this relationship between the cages and pins 30. The pins 30 are rotatably supported in the cages 16 to carry the rollers 17 so that they have the desired contact with the kelly K as will be subsequently described. The invention preferably includes means for lubricating the roller carrying pins 30. Vertical openings 33 are provided in the end parts or ends 25 of the cages 16 and communicate with the several pin carrying openings 32. Grease gun fittings 34 are provided at the upper ends of the openings 33 whereby lubricant may be supplied to the openings 33 under pressure to lubricate the projecting end portions of the pins 30.

The shape of the rollers 17 and the relationship of the rollers to the kelly are important features of the invention. In accordance with the invention the rollers 17 are formed or shaped to each have extensive cooperation with a side or surface 11 of the kelly K. The rollers 17 are frustoconical or tapered, each having a longitudinally tapered peripheral surface 35 for contacting a surface 11 of the kelly K when the rotary table T is turned in the forward or right-hand direction indicated by the arrow in Fig. 3 of the drawing. The surfaces 35 are smooth and regular and preferably extend to the advancing or forward ends of the rollers 17 relative to the forward direction of rotation of the table T. The sur-

faces 35 have a relatively slight taper or pitch, the pitch of the surfaces being dependent to some extent upon the clearance between the kelly K and the rollers 17. It is preferred that the surfaces 35 be of substantial extent or length. The rollers 17 are preferably proportioned so that their surfaces 35 have their inner ends or their trailing ends, relative to the direction of forward rotation of the table T, at the centers of the adjacent surfaces 11 of the kelly K when the rollers are in contact with the kelly. In the arrangement illustrated in the drawing where the rollers 17 have their opposite ends unequally spaced from the adjacent sides of the kelly K the driving surfaces 35 have a length greater than one half the length of the rollers. The taper or pitch of the surfaces 35 is such that the surfaces come into full engagement with the surfaces 11 of the kelly K when rotation of the table T is initiated. The surfaces 35 are sufficiently long to have engagement with the kelly surfaces 11 throughout at least one half of their widths.

The trailing end portions of the rollers 11 relative to the forward direction of rotation of the table T are adapted to have cooperation with the kelly K when the table T is turned in a left hand or reverse direction. The surfaces 36 occurring on the trailing end portions of the rollers 17 are preferably tapered in the opposite direction to the surfaces 35. The taper of the surfaces 36 is substantially equal to the taper of the surfaces 35 although the surfaces 36 are of less length than the surfaces 35 as described above. The surfaces 36 may extend from the inner ends of the driving surfaces 35 to the trailing ends of the rollers 17. The tapered surfaces 35 and 36 join at circumferential lines 37. The rollers 17 are rotatably supported in the cages 16 so that the lines 37 have only slight or essential clearance with the kelly K. Accordingly, when the table T is turned in the direction indicated by the arrow in Fig. 3 the driving surfaces 35 almost immediately come into full cooperation with the surfaces 11 of the kelly K. It is preferred to make the clearance between the lines 37 and the kelly K slight so that the taper of the surfaces 35 may be gradual as illustrated.

The means 18 is provided to lock or retain the cages 16 in the body 15. The means 18 preferably includes a simple retaining member in the form of a ring 40. The ring 40 is removably secured to the upper end portion of the body 15. The extreme upper end part of the body 15 has a cylindrical outer surface and is screw threaded to receive the ring 40. The ring 40 is provided with an inwardly projecting flange 41 which is adapted to engage the upper end of the body 15 when the ring is fully threaded on the body. The flange 41 is proportioned to extend inwardly beyond the upper end of the body 15 to project over and engage the upper ends of the cages 16. The flanged ring 40 thus operates to hold the cages 16 in their proper positions in engagement with the flange 24. The ring flange 41 is proportioned so that it does not engage or interfere with the kelly K and so that it does not render the grease fittings 34 inaccessible. The retaining ring 40 is preferably locked or set in position so that it cannot work loose. Diametrically opposite outwardly projecting lugs 42 are provided on the ring 40 and similar lugs 43 are provided on the four corners of the main portion 22 of the body 15. Bolts 44 are removably arranged through openings in the lugs 42 and 43 to definitely lock the ring 40 against unthreading.

During operation of the apparatus illustrated in the drawing the rotary table T may be rotated in the direction indicated by the arrow in Fig. 3 to drive or rotate the drilling string. As above described, the body 15 of the Kelly bushing turns with the table T and the rollers 17 rotatably mounted within the body 15 cooperate with the kelly K to transmit the driving or rotative forces to the kelly. The kelly K may be moved or shifted vertically during its rotation by the Kelly bushing and the rotation transmitting rollers 17 being rotatable offer a minimum of resistance to such vertical shifting of the kelly. Accordingly vertical shifting of the kelly K during its rotation does not impose additional weight or load on the rotary table and the rollers 17 allow the drill string to be moved vertically in a uniform or regular manner for the better control of the tools connected therewith. The four series of vertically spaced rollers 17 are rotatably carried in the cages 16 to contact the four surfaces 11 of the polygonal kelly K. As described above, the rollers 17 are shaped to maintain long or extensive surfaces 35 in driving engagement with the Kelly surfaces 11.

Prior to rotation of the table T the parts may be in the relative positions illustrated in Fig. 2 of the drawing where the lines 37 have slight clearance with the sides of the kelly K and the surfaces 35 and 36 of the rollers 17 are out of contact with the kelly. When rotation of the table T is started in the direction indicated by the arrow in Fig. 2 the initial movement of the table brings the roller surfaces 35 into full engagement with the surfaces 11 of the kelly K. This relationship between the rollers 17 and the kelly K is illustrated in Fig. 3 of the drawing. It will be observed that the surfaces 35 have extensive engagement with the surfaces 11 of the kelly K being pitched or tapered so that they engage the kelly throughout their lengths. Accordingly, the rollers 17 maintain extensive surfaces in driving engagement with the kelly K for the transmission of rotation to the kelly. As described above, the surfaces 35 of the rollers 17 may engage the Kelly surfaces 11 throughout one half of their widths or more. The pluralities of spaced rollers 17 having the extensive surfaces 35 in full contact with the kelly K dependably drive or rotate the kelly. As the individual rollers 17 are independently rotatable the kelly K may be moved vertically while being driven with a minimum of friction and resistance. Accordingly, the tool or tools operated on the drilling string may be evenly and smoothly advanced and there is a minimum of additional load placed on the rotary table T when the kelly K is fed downwardly. When the rotary table T is rotated in the reverse direction or the direction opposite to that indicated by the arrow in Fig. 3 the surfaces 36 of the rollers 17 come into contact with the surfaces 11 of the kelly K. These tapered surfaces 36 of the roller 17 are pitched to have full engagement with the surfaces of the kelly for the dependable positive transmission of the rotative forces to the kelly.

The rollers 17 of the bushing provided by the present invention are mounted and formed to have long or extensive surfaces in driving contact with the flat surfaces of the kelly K as distinguished from the prior devices which usually have only point or line contact with the kelly. The extensive engagement between the rollers 17 and the kelly K materially reduces wear of the rollers and kelly and prevents the kelly from be-

coming grooved or worn off at its corners. Further, the tapered rollers of the present invention are longer lived than the cylindrical rollers heretofore employed.

- 5 Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear
10 to those skilled in the art or fall within the scope of the following claims:

Having described my invention, I claim:

1. A bushing for use in a rotary table for en-
15 gaging a polygonal drill stem extending there-
through, said bushing including, a body for ar-
rangement in the table and having recesses op-
posing the side surfaces of the drill stem, the cen-
20 tral vertical axes of the recesses being offset from
the central vertical axes of the opposing side sur-
faces of the drill stem, and rollers mounted in
the recesses for rotation about substantially hori-
zontal axes, each of said rollers having tapered
25 surfaces of unequal lengths joining at a plane
coincident with the central vertical axis of the
adjacent side surface of the drill stem for coop-
erating with the drill stem to transmit driving
forces thereto.
2. A bushing for use in a rotary table for trans-
30 mitting rotation to a polygonal drill stem extend-
ing through the table, said bushing including, a
body for arrangement in the table, a plurality of
rollers supported in the body for rotation, sur-
face parts on said rollers normally receiving the
35 drill stem with clearance and being in the same
vertical planes as the central vertical axes of the

adjacent side surfaces of the drill stem, and sur-
faces of unequal lengths on said rollers tapering
from said parts to fully bear on the sides of the
stem when the table is rotated.

3. A bushing for use in a rotary table for trans- 5
mitting rotation to a polygonal drill stem extend-
ing through the table, said bushing including, a
body for arrangement in the table, a plurality of
rollers supported in the body for rotation, each of
10 said rollers having a surface part normally re-
ceiving the drill stem with clearance, and tapered
surfaces of unequal lengths extending in opposite
directions from said parts to cooperate with the
sides of the drill stem when the table is rotated
15 in opposite directions.

4. A bushing for use in a rotary table for trans- 15
mitting rotation to a polygonal drill stem extend-
ing through the table, said bushing including, a
body for arrangement in the table, a plurality of
cages inserted in the body, each cage having a 20
vertical recess opposing a side surface of the po-
lygonal drill stem, the central vertical axes of the
recesses being offset from the central vertical
axes of the opposing side surfaces of the drill
stem, means retaining the cages in the body, and 25
a plurality of vertically spaced rollers rotatably
supported by each cage for independent rotation
in the recesses of the cages, each roller having a
surface part unequally spaced between its ends
30 and aligned with the central vertical axis of the
adjacent side surface of the drill stem and having
tapered surfaces extending in opposite directions
from said surface part for contacting the drill
stem.

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