Jan. 17, 1939. G. D. JOHNSON 2,144,156

ROTARY TABLE BUSHING

Filed Dec. 10, 1937

Fig. 1.

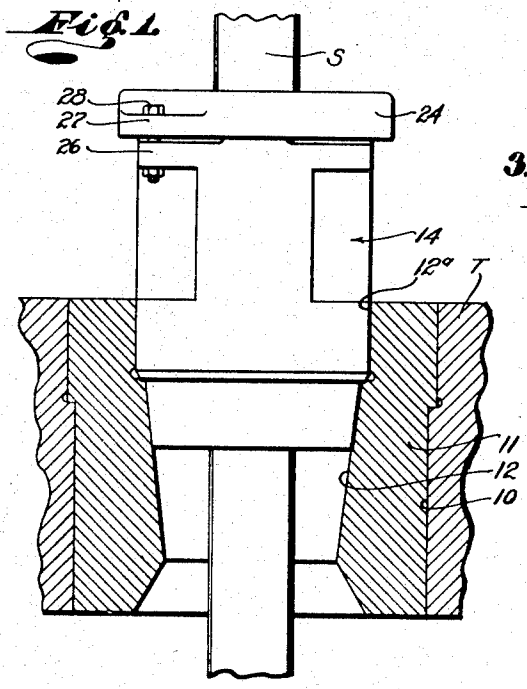


Fig. 2.

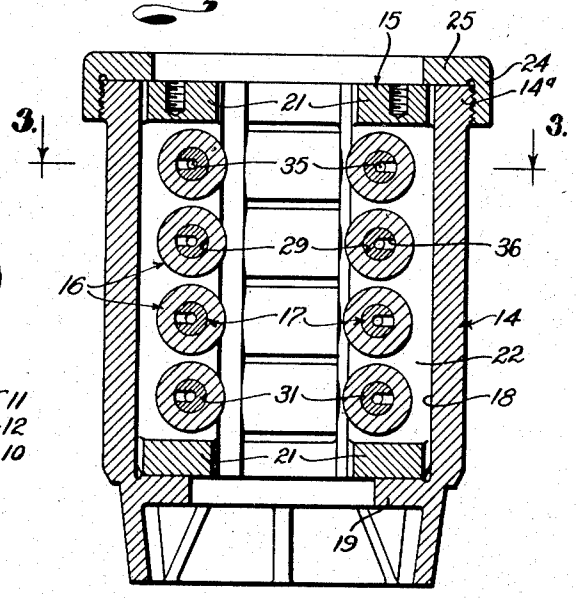


Fig. 3.

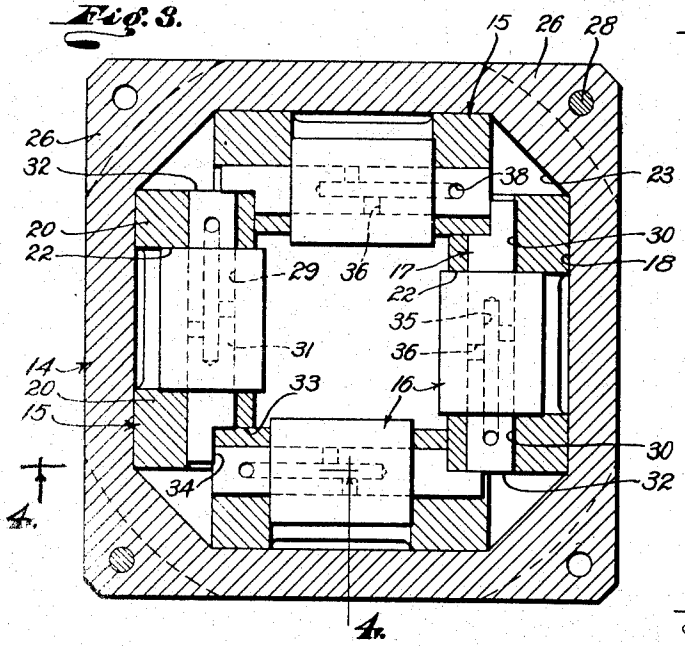


Fig. 4.

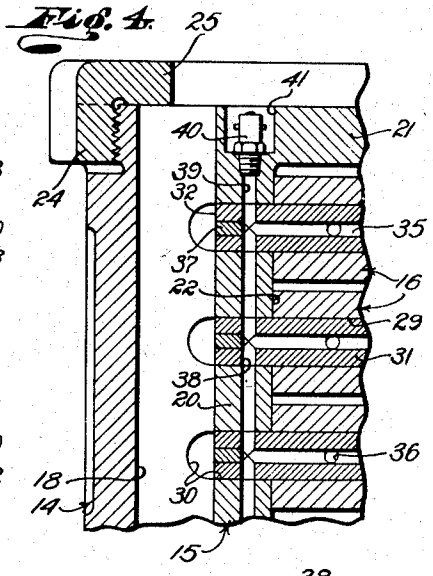


Fig. 5.

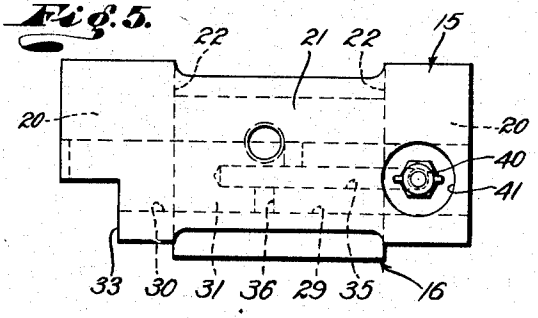
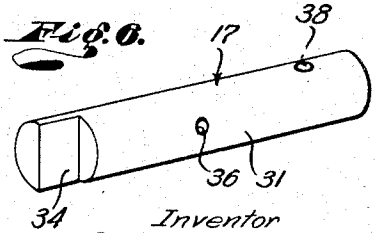


Fig. 6.



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2,144,156

ROTARY TABLE BUSHING

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11 Claims. (Cl. 255—23)

This invention relates to well drilling equipment and relates more particularly to a Kelly bushing or drive bushing for the rotary table of a well drilling rig. A general object of this invention is to provide an improved, simplified and readily serviced drive bushing of the roller type.

A type of drive bushing now in extensive use includes a shell or body, a plurality of cages removably arranged in the body and rollers on the cages for contacting the polygonal drill stem to transmit rotation thereto. In mounting the rollers it has been the usual practice to fix the rollers on pins and rotatably support the pins in openings in the cages. After a period of use the pins wear the openings out of round and in order to recondition the bushing for further use it is necessary to discard the cages as well as the worn rollers and pins and install new or replacement cages having new pins and rollers.

Another object of this invention is to provide a drive bushing of the character mentioned in which the cages receive little or no wear and therefore do not require replacement.

Another object of this invention is to provide a drive bushing of the roller type in which the rollers are rotatable on supporting pins and the pins are held against axial movement and rotation so they do not wear the cages.

Another object of this invention is to provide a drive bushing of the character referred to embodying simple, effective and inexpensive means for lubricating the rollers and their supporting pins.

The various objects and features of this 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 bushing provided by this invention showing it in engagement with a drill stem and seated in a rotary table, the rotary table being shown in vertical cross section. Fig. 2 is an enlarged vertical detailed sectional view of the bushing removed from the table. Fig. 3 is an enlarged horizontal detailed sectional view taken as indicated by line 3—3 on Fig. 2. Fig. 4 is a fragmentary vertical detailed sectional view taken substantially as indicated by line 4—4 on Fig. 3 illustrating the lubricating means for a series of rollers. Fig. 5 is an enlarged top or plan view of one of the cages and its rollers and Fig. 6 is an enlarged perspective view of one of the roller supporting pins.

The bushing of the present invention is intended for use on the rotary table of a rotary well drilling rig to transmit rotation to the polygonal Kelly or drill stem of the drilling string. In the drawing I have illustrated a typical preferred form of the invention and in Fig. 1 I have shown the bushing arranged in a rotary table T to cooperate with a tubular externally polygonal drill stem S. The portion of the typical rotary table illustrated in Fig. 1 is provided with a central vertical opening 10. A master bushing 11 is arranged in the table opening 10 and has a central vertical opening 12. The upper portion 12a of the opening 12 is polygonal while the major portion of the opening 12 is round in cross section and tapered. It is to be understood that the rotary table T is adapted to be driven or rotated in the usual manner and that the drilling string and the drilling tools are adapted to be passed through the opening 12 in the master bushing 11. The Kelly or drill stem S shown in the drawing is of conventional or typical construction and is an elongate member of substantially square horizontal cross section.

The drive bushing provided by the present invention includes, generally, a body 14 adapted to be seated in the opening 12 of the master bushing 11, a plurality of cages 15 in the body 14, pluralities of rollers 16 and means 17 for rotatably supporting the rollers 16 on the cages 15.

The bushing body 14 is provided to carry or contain the cages 15 and is intended to be arranged in the opening 12 of the bushing 11 to rotate with the rotary table T. The body 14 is a tubular structure or member having a central longitudinal opening 18. The lower portion of the body 14 is round in horizontal cross section and is tapered to fit or seat in the tapered major portion of the master bushing opening 12. The main or upper portion of the body 14 is substantially square in horizontal cross section to fit the upper portion 12a of the opening 12. The opening 18 in the body 14 passes or receives the drill stem S with substantial clearance and is preferably substantially square in horizontal cross section to receive the cages 15. A transverse or horizontal flange 19 projects from the wall of the opening 18 adjacent the lower end of the opening. The flange 19 serves to support the cages 15 in the body 14 as will be subsequently described. The extreme upper end portion 14a of the body 14 preferably has a cylindrical external surface.

The cages 15 are removably arranged in the body 14 to carry the rollers 16. Where the bush-

ing is provided to cooperate with a square drill stem S there are four similar or like cages 15 arranged in the body 14. The cages 15 are rectangular frame-like structures each including spaced vertical sides 20 and horizontal upper and lower ends 21 extending between and connecting the sides 20. The lower ends 21 of the cages 15 rest on the flange 19 to support the cages in the body 14 and the outer surfaces of the cages are adapted to bear outwardly against the vertical walls of the square body opening 18. The opposing inner surfaces 22 of the sides 20 are preferably flat and vertical. The opening 18 of the body 14 is provided with diagonal corner walls 23 cooperating with the outer corners of the cages 15 to assist in retaining the cages in proper position in the body. The inner corner portions of the cages 15 cooperate or mesh to assist in holding the cages in proper position as will be more fully described. The cages 15 arranged against the four side walls of the opening 18 define a vertical opening of square horizontal cross section adapted to pass the drill stem S with clearance.

Means is provided on the body 14 to removably retain or hold the cages 15 against vertical movement or displacement. This means includes a retaining ring 24 threaded on the cylindrical upper portion 14a of the body 14. The ring 24 is provided with an annular inwardly projecting flange 25 that partially overhangs the upper end of the body opening 18. The flange 25 is adapted to cooperate with the upper surfaces of the cages 15 to hold the cages down against the flange 19. The retaining ring 24 is preferably locked in a position where it holds the cages against vertical movement. Ears 26 project from the exterior of the body 14 and similar ears 27 are provided on the ring 24. Bolts 28 are arranged through openings in the ears 26 and 27 to definitely prevent rotation and loosening of the ring 24.

The rollers 16 are rotatably mounted on the cages 15 by the means 17 and are provided to cooperate with the drill stem S to transmit turning forces thereto and to permit vertical shifting or feeding of the drill stem. There is preferably a plurality of rollers 16 for each cage 15 and the several rollers 16 are preferably identical. The rollers 16 are cylindrical members and are preferably hardened to be long wearing. The stem engaging rollers 16 are tubular, being provided with central longitudinal openings 29. The opposite ends of the rollers 16 are preferably flat and normal to the longitudinal axes of the rollers.

The means 17 serve to rotatably support the rollers 16 in the cages 15 for rotation about substantially horizontal axes. The means 17 are important features of the invention as they serve to support the rollers 16 in such a manner that they do not wear the cages 15. The means 17 includes or provides vertically spaced pairs of aligned horizontal openings 30 in the sides 20 of the cages 15. The openings 30 preferably pass completely through the sides 20 of the cages and are of equal diameter. The means 17 further include pins 31 seated or arranged in the openings 30 and passing through the openings 29 in the rollers 16 to rotatably support the rollers. The rollers 16 are positioned between the spaced sides 20 of the cages 15 and the pins 30 are arranged to have their opposite end portions supported in the openings 30 and to extend through the openings 29 of the rollers to support the rollers for rotation about substantially horizontal axes. The pairs of aligned pin carrying openings 30 of the several cages may be in the same horizontal planes so that the rollers 16 are in corresponding positions on the cages. The parts are related and proportioned so that the rollers 16 rotatably supported on the pins 31 as just described, project inwardly beyond the inner surfaces of the cages 15 to contact the flat side surfaces of the polygonal drill stem S. The pins 31 are preferably solid members of uniform diameter.

The means 17 further includes a novel and very effective arrangement of parts for holding the pins 31 against rotation and axial movement so that the pins do not wear the openings 30 in the cages 15. One end 32 of each pin 31 is flat and flush with the other side surface of one side 20 of its respective cage 15. The said flat ends 32 of the pins 30 are flush with corresponding outer side faces of the cage sides 20. One side 20 of each cage 15 has a vertically extending recess or notch 33 in its inner corner portions. The notches 33 have flat vertical walls and are shaped and proportioned to receive the inner corner portions of adjacent cages 15. The notches 33 partially intersect or join the pin receiving openings 30. Each pin 31 is provided with a flat walled notch 34 in the end portion opposite to the plain flat end 32. The walls of the notches 34 are adapted to lie flush with the walls of the notches 33 in the cage sides 20. The parts are related and proportioned so that the plain ends 32 of the pins 31 are flush with the adjacent outer side surfaces of the sides 20 when the walls of the notches 34 are flush with the walls of the notches 33 in the opposite cage sides 20. The plain or unnotched inner corner portions of the cages 15 cooperate with the notches 33 of adjacent cages 15 to interlock the cages in the proper positions and cooperate with the notches 34 in the pins 31 in said adjacent cages 15 to positively prevent rotation of the pins and endwise movement of the pins in one direction. The plain ends 32 of the pins 31 cooperate with or engage the axial walls of the notches 34 in the pins 31 carried by adjacent cages 15 to asist in preventing rotation of the last named pins and to prevent axial movement of the first named pins in the other direction. Thus it will be seen that the transverse walls of the notches 34 cooperate with the inner surfaces of the sides 20 of the adjacent cages 15 to prevent axial movement of the pins 31 in one direction while the plain ends 32 of the pins cooperate with the axial walls of the notches 34 in the pins carried by adjacent cages 15 to prevent axial movement of the pins in the other direction and the inner corner portions of adjacent cages 15 have side surfaces cooperating with the axial walls of the notches 34 in the pins to positively prevent rotation of the pins. The meshing parts of the cages 15 and the pins 31 serve to positively hold the pins against movement so that they canot wear the openings 30.

Means are provided to lubricate the pins 31 and the rollers 16. Each pin 31 is provided with an axial lubricant duct 35 and lateral ducts 36 communicate with the duct 35 and discharge into a roller opening 29. The longitudinal ducts 35 may extend inwardly from the plain ends 32 of the pins 31 and their outer parts may be closed by plugs 37. Vertical or transverse ports 38 are provided in the pins 31 to communicate with the axial ducts 35. A substantially vertical lubricant port 39 extends downwardly through one side 20 of each cage 15 to register with the ports 38 in the several pins 31 carried by the cage. Grease gun fittings 40 are provided in

the upper ends of the ports 39 to facilitate the delivery of lubricant to the ports. The fittings 40 may be contained in sockets 41 in the upper surfaces of the cage sides 20. The notches 34 in the pins 31 cooperating with the corner portions of the adjacent cages 15 maintain the pins in the rotative positions where their ports 38 are in registration with the main lubricant ports 39. It will be apparent how lubricant under pressure introduced through the fittings 40 passes to the openings 29 in the rollers 16 to lubricate the pins and the rollers.

During the operation of the drilling apparatus the rotary table T is rotated in the usual manner and as the drive bushing rotates with the table the rollers 16 contact the sides of the polygonal stem S to transmit the turning forces thereto. The rollers 16 are supported for free rotation on their pins 31 so that the drill stem S may be fed downwardly or moved longitudinally with a minimum of friction while being rotated. The rollers 16 supported on the pins 31 as described above rotate about horizontal axes and are of sufficient length to have extensive engagement with the flat sides of the polygonal stem S. The surfaces 22 are engageable by the rollers 16 to prevent endwise movement of the rollers. The pins 31 are positively held against turning, by the end portions of the adjacent cages 15 and the pins 31 cooperating with the notches 34, and the pins are definitely held against endwise movement by such cooperation. Accordingly, rotation of the rollers 16 through their engagement with the drill stem S cannot produce movement of the pins 31 and the pins do not wear in the openings 30. As the cages 15 are not engaged by the drill stem S and as the pins 31 do not wear the openings 30 in the cages, the cages are subjected to little or no wear and last indefinitely.

When the rollers 16 or the pins 31 or both become worn the ring 24 may be removed from the body 14 and the cages 15 may be removed from the body for the purpose of replacing the pins and rollers. When the cages 15 are removed from the body 14 the worn pins 31 may be readily driven or slid from their openings 29 and 30. The new or replacement pins 31 and rollers 16 may be easily and quickly mounted in the cages 15 and the cages provided with the replacement parts may be re-inserted in the body 14 for further use. The bushing of the present invention is such that it may be fully reconditioned for use by merely replacing the simple inexpensive rollers 16 and pins 31.

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 to those skilled in the art or fall within the scope of the following claims:

Having described my invention, I claim:

1. A drive bushing of the character described including a body, cages in the body having openings, pins carried in the openings, rollers rotatable on the pins, and surfaces on one cage holding the pins of another cage against rotation.

2. A drive bushing of the character described including a body, cages in the body having openings, pins carried in the openings, rollers rotatable on the pins, and cooperating surfaces on the pins of a given cage and on the adjacent cages preventing rotation of the pins.

3. A bushing for driving a drill stem of a drilling string comprising a body, cages in the body having openings, pins in the openings having flat axially extending faces, rollers rotatable on the pins for engaging with the drill stem, and means for holding the pins against rotation including a cage part cooperating with said face of a pin on another cage.

4. A bushing for driving a drill stem of a drilling string comprising a body, cages in the body having openings, pins in the openings having notches, rollers rotatable on the pins and adapted to engage the drill stem, and means for holding the pins against rotation including surfaces of a cage extending into the said notch in the pin on another cage.

5. A bushing for driving a drill stem of a drilling string comprising a body, cages in the body having openings, each cage having a notch in a corner joining its opening, the cages being assembled with a corner portion of one cage fitting the said notch in an adjacent cage, pins arranged in said openings having notches registering with the first named notches to cooperate with the said corner portions, and rollers rotatable on the pins.

6. A bushing for driving a drill stem of a drilling string comprising a body, cages in the body having openings, each cage having a notch in one corner, the cages being assembled about the drill stem with a corner portion of one cage received in the notch of an adjacent cage, a pin arranged in each opening and having a notch engaged by a said corner portion of a cage to be held against rotation thereby, and rollers rotatable on the pin to cooperate with the drill stem

7. A bushing for driving a drill stem of a drilling string comprising a body, cages in the body having openings, each cage having a notch in one corner, the cages being assembled about the drill stem with a corner portion of one cage received in the notch of an adjacent cage, a pin arranged in each opening and having one end engaged by a said corner portion of a cage to be held against rotation and axial movement in one direction and having its other end engaged by a pin on another cage to be held against axial movement in the other direction, and rollers rotatable on the pins and adapted to cooperate with the drill stem.

8. A drive bushing for rotating a drill stem comprising, a body having an opening, a plurality of supporting members arranged in the opening to define a polygonal opening for receiving the stem, each member having a vertical notch in one corner receiving the corner portion of an adjacent member, the members having spaced openings joining said notches, pins arranged in the openings and having notches registering with the first mentioned notches to be held against rotation by the corner portions of the members received therein, and rollers rotatable on the pins to cooperate with the stem.

9. A drive bushing for rotating a drill stem comprising, a body having an opening, a plurality of supporting members arranged in the opening to define a polygonal opening for receiving the stem, each member having a vertical notch in one corner receiving the corner portion of an adjacent member, the members having spaced openings joining said notches, pins arranged in the openings and having notches registering with the first mentioned notches to be held against rotation and axial movement in one direction by the corner portions of the members received therein, the pins of adjacent members cooperating to prevent axial movement of the pins in the

other direction, and rollers rotatable on the pins.

10. A bushing for driving a drill stem of a drilling string comprising a body, cages in the body having openings, each cage having a notch in a corner joining its opening, the cages being assembled with a corner portion of one cage fitting the said notch in an adjacent cage, pins arranged in said openings having notches registering with the first named notches to cooperate with the said corner portions, and rollers rotatable on the pins, the cages having lubricant passages, and the pins having lubricant ducts registering with the cages.

11. A drive bushing for rotating a drill stem comprising, a body having an opening, a plurality of supporting members arranged in the opening to define a polygonal opening for receiving the stem, each member having a vertical notch in one corner receiving the corner portion of an adjacent member the members having spaced openings joining said notches, pins arranged in the openings and having notches registering with the first mentioned notches to be held against rotation and axial movement in one direction by the corner portions of the members received therein, the pins of adjacent members cooperating to prevent axial movement of the pins in the other direction, and rollers rotatable on the pins, the members having lubricant passages intersecting said openings, and the pins having lubricant ducts registering with the said passages.

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