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ROTARY TABLE AND PRESSURE FLUID SEAL THEREFOR

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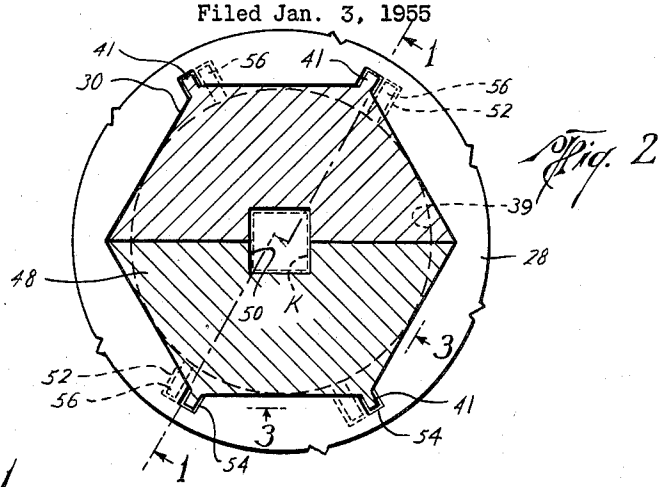


Fig. 2

Fig. 1

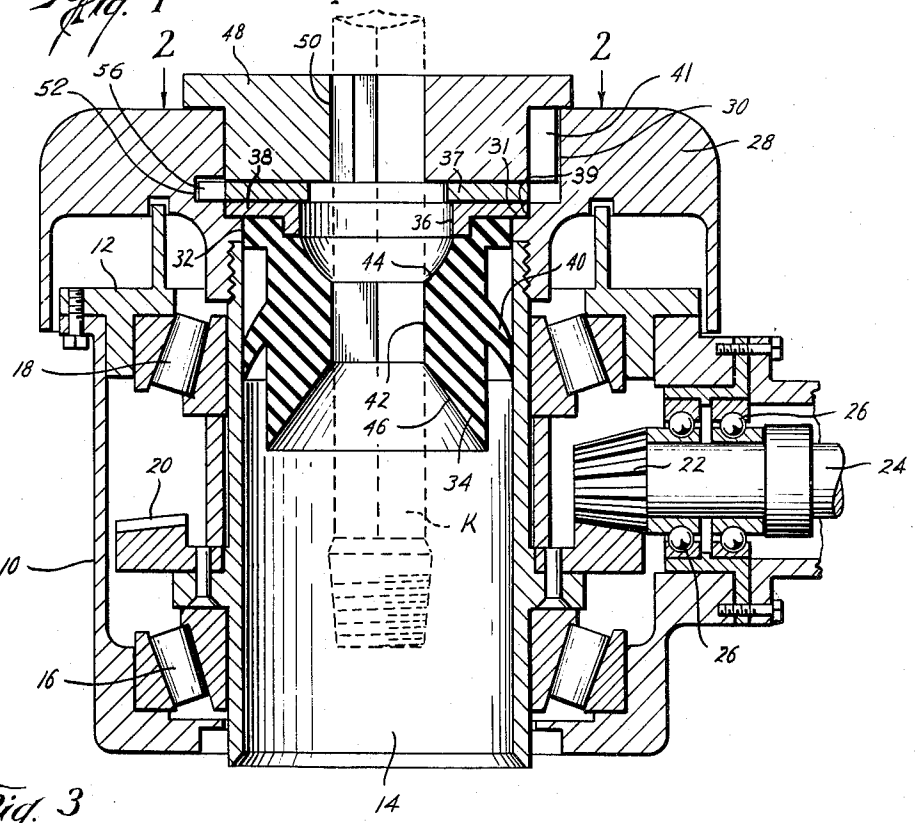
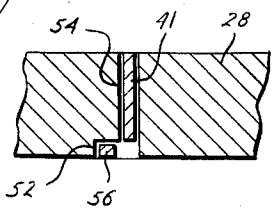


Fig. 3



Henry H. Collins
INVENTOR.

BY Charles E. Lightfoot
ATTORNEY

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ROTARY TABLE AND PRESSURE FLUID SEAL THEREFOR

Henry H. Collins, Houston, Tex.

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4 Claims. (Cl. 255—23)

This invention relates to a rotary table and pressure fluid seal therefor, and more particularly to a seal forming device for use with a rotary table of the type used in well drilling operations, and which is adapted to form a fluid tight seal between a kelly extending through the table and a surrounding sleeve forming a part of the rotary table assembly.

In carrying out well drilling operations by the rotary drilling method rotary table mechanism is employed, which includes a rotatably supported driving element having a substantially rectangular opening therethrough through which a kelly of rectangular cross-section is slidably extended, whereby the kelly may be turned and is capable of vertical movement relative to the table during such rotation. The kelly is attached at its lower end to the upper end of a section of drill pipe which is lowered into the well and rotated during the drilling operation. When the drilling operation has proceeded until the kelly has been lowered as far as possible, the kelly and drill string are raised to connect another section of drill pipe into the string, whereupon the kelly is reconnected to the new section and the drilling operation is resumed.

As heretofore conducted, this method of drilling presents the disadvantage that it is very difficult to prevent leakage of well fluid, drilling mud and the like, between the kelly and the rotary table. Various types of sealing means to prevent such leakage have been proposed, but due to the upward pressure of the well fluid and the movement of the kelly, such expedients have not proven entirely satisfactory. Moreover, because of the necessity of frequently withdrawing the kelly from the rotary table during the drilling process it has been found very difficult to maintain any type of seal between the kelly and the rotary table.

The torque imposed on the drill pipe during the drilling operation often causes the pipe to be twisted so that it tends to reverse its direction of rotation, and this reverse rotation or back lashing of the drill pipe makes its difficult if not impossible to maintain a fluid tight seal between the kelly and the rotary table by the use of sealing means of conventional construction.

The present invention has for an important object the provision in a rotary table of sealing means disposed in surrounding relation to a kelly extending through the table, to form a fluid tight seal between the kelly and table to prevent leakage of well fluid past the kelly during the drilling operation.

Another object of the invention is to provide a rotary table having Kelly sealing means forming a fluid tight seal between the table and a kelly extending therethrough, and also having means for driving the kelly which is constructed to support the sealing and wiping means and to permit limited rotation of the kelly relative to the sealing means, whereby excessive wear or damage to the sealing means due to misalignment of the kelly and sealing means may be prevented.

A further object of the invention is the provision of sealing means constructed to form a fluid tight seal between a kelly and a rotary table and which also serves as a wiper for the kelly as the same is withdrawn from the well.

A further object of the invention is the provision of sealing means of the kind referred to having an opening therethrough corresponding in shape to the cross-sectional shape of a kelly, and through which the kelly is adapted to be extended, and which serves to wipe the kelly as the same is withdrawn from the well bore.

Another object of the invention is to provide a combined Kelly sealing and wiping element for rotary tables, which is constructed to form a fluid tight seal between a kelly and rotary table mechanism for driving the same, and whose sealing effect is increased upon an increase in the upward pressure of fluid in the well bore.

A still further object of the invention is to provide a Kelly wiper and seal which is of simple design and rugged construction capable of withstanding the extreme conditions of wear and hard usage to which equipment of this kind is customarily subjected.

The above and other important objects and advantages of the invention may best be understood from the following detailed description, constituting a specification of the same when considered in conjunction with the accompanying drawings wherein—

Figure 1 is a vertical cross-sectional view, taken along the line 1—1 of Figure 2, looking in the direction indicated by the arrows, illustrating a rotary drilling table embodying the invention;

Figure 2 is a cross-sectional view taken along the line 2—2 of Figure 1, looking in the direction indicated by the arrows; and

Figure 3 is a fragmentary cross-sectional view taken along the line 3—3 of Figure 2, looking in the direction indicated by the arrows, showing details of construction of the Kelly driving mechanism of the rotary table of the invention.

Referring now to the drawings in greater detail, the invention is illustrated in connection with its use in conjunction with a rotary table structure of conventional design having a casing or housing, which includes a shell **10** and a cover **12**, enclosing driving mechanism by which the table is operated.

A sleeve **14** extends centrally through the housing and is supported for rotation therein on suitable bearings, such as those indicated at **16** and **18**, and to this sleeve there is attached a ring gear **20** positioned in engagement with a pinion **22** attached to a drive shaft **24** which is rotatably supported in bearings **26** carried by the housing.

It will be apparent that by this arrangement the sleeve **14** may be rotated in the housing in the usual manner by operation of the drive shaft **24** from any suitable source of power.

An annular table top member **28** is attached to the upper end of the sleeve **14** for rotation therewith in a horizontal position, this top member being shaped to extend over the cover **12** of the housing, and having a central upwardly opening recess **30** therein which is of polygonal shape and whose bottom is provided with an opening **32** positioned concentrically relative to the sleeve.

Within the sleeve **14** there is a seal forming element **34**, which is attached at its upper end to an annular member **36** having an external annular flange **38** which seats in a counterbore **39** within the recess **30**. The counterbore **39** forms an upwardly facing shoulder **31** below the bottom of the recess **30**, upon which the annular flange **38** rests. The seal element **34** is preferably formed of resilient material, such as rubber, or the like and has an external, annular, downwardly cupped, flexible, flange **40** positioned to sealingly engage the interior of the sleeve. Beneath the flange **40** and for some distance

above the same, the external surface of the seal element is spaced radially inwardly of the interior of the sleeve **14**, to allow the element to expand outwardly when the lower end of a kelly is forced through the seal element. The seal element has a central opening **42** therethrough whose shape corresponds to the cross-sectional shape of a kelly, indicated at K which extends through said opening and with which the seal member forms a fluid tight seal. Above and below the opening **42** the interior of the member **34** is flared outwardly as seen at **44** and **46**.

Above the annular member **36** a retainer ring or hold down member **37** is positioned.

An annular Kelly drive bushing **48**, is positioned in the recess **30** of the table top **28**, on the hold down or retainer member **37**, and is provided with a central opening **50** therethrough which is shaped to fit the Kelly K extending therethrough. The table top **28** has radially inwardly opening recesses **52** disposed at convenient peripherally spaced intervals therearound, and is formed with vertical inwardly opening grooves **54** which open at their lower ends into said recess and whose upper ends open outwardly at the upper surface of the table top, and the hold down or retainer member **37** has radially extending lugs **56** thereon which are positioned to extend into the recesses **52** and which are of a width to enter the grooves **54**.

The hold down or retainer **37** may be inserted in the recess **30** by positioning the lugs **56** in alignment with the grooves **54** and lowering the member into the recess it rests upon the bottom of the recess, and by turning the member the lugs **56** may then be caused to move away from the grooves **54** in the recesses **52**, whereupon the member will be held against removal from the table.

The bushing **48** is formed with downwardly and radially outwardly extending lugs or key portions **41**, which are spaced peripherally of the bushing to enter the grooves **54**, and which extend downwardly into engagement with the bottom of the recess, when the bushing is in place therein, to close the grooves to prevent rotation of the hold down member **37**, so that the lugs **56** are prevented from entering the grooves, thus holding the hold down member against accidental displacement.

The bushing **48** may be divided centrally to enable it to be readily assembled about the kelly which will then extend through the opening **50**, and the bushing may then be inserted in the recess **30**.

To remove the hold down or retainer member **37** and the seal element **34**, the bushing **48** is first lifted out of the recess **30** and the member may then be turned in the opposite direction to realign the lugs **56** with grooves **54**, and lifted out of the table.

In making use of the invention, constructed as described above, the bushing **48** is removed from the table and the lower end of the Kelly K inserted through the opening **42** of the seal member **34**, the member being expansible to permit the enlarged lower end portion of the kelly to be readily forced through the opening, and thereafter to contract into sealing engagement with the polygonally shaped portion of the kelly. The bushing **48** is then assembled about the kelly and inserted in the recess **30**. In this condition of the apparatus the parts will be in the positions shown in Figure 1 and the kelly may be rotated in the usual manner to rotate a drill pipe attached to its lower end.

During the drilling operation the upward pressure of well fluid, such as drilling mud, in the sleeve **14** will expand the seal element **34** to sealingly engage the cupped flange **40** thereof with the interior of the sleeve and to cause the element to sealingly engage the kelly about the opening **42**. When the drilling has progressed to the extent that it becomes necessary to add an additional section to the drill pipe, the kelly may be raised, the seal element being expanded by the enlarged lower end portion of the kelly to permit the same to pass through the opening **42**, whereupon the element will be in sealing engagement with the exterior of the drill pipe. The kelly is then detached, a new section of drill pipe connected to the drill string and the kelly reconnected to the new section. The drill string may then be lowered until the kelly is again extended through the opening **42** and the drilling operation resumed.

By operating the invention in this manner it will be apparent that the seal element is effective at all times to maintain a fluid tight seal between the sleeve **14** and the drill pipe and that the kelly may be withdrawn, additional drill pipe connected in, and the drilling operation resumed without releasing the pressure in the well and without danger of upward leakage of fluid therefrom. The seal element **34** also serves to wipe mud from the kelly and the drill pipe as the same is raised, so that the portion extending above the table will be clean and the escape of mud from the well is prevented.

The opening **42** in the seal element **34** may be formed with rounded corners, if desired, for added strength and to prevent distortion and tearing of the resilient material.

In the event that the kelly should be improperly oriented in inserting the same through the opening **42**, the hold down ring or retainer **37** may turn somewhat in the recess **30** thus permitting the seal element to move to bring the opening **42** into registration with the kelly to prevent stretching or distortion of the element when the kelly is forced through the opening.

It will thus be seen that the invention provides a rotary table structure and a seal forming device for the same which is simple and economical in construction, efficient in operation, and wherein the parts are easily replaceable.

The invention has been disclosed herein in connection with a certain specific embodiment of the same, but it will be understood that this is intended by way of illustration only, and that numerous changes can be made in the construction and arrangement of the various parts, without departing from the spirit of the invention or the scope of the appended claims.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent is:

1. In a rotary drilling table, Kelly driving mechanism comprising a table element formed with a central, upwardly opening recess and a vertical aperture in communication with the recess, a tubular sleeve carried by said element in concentric relation to said aperture, means for supporting said element for rotation about a vertical axis, a driving bushing positioned in said recess and having a central opening disposed in concentric relation to the aperture and through which a kelly may be slideably extended, said bushing being engageable with the kelly in said opening to rotate the kelly with the bushing, interengageable means on the element and bushing for causing the bushing to rotate with the element, a tubular seal forming member supported on the table element extending into said sleeve in surrounding relation to the kelly and in sealing engagement therewith and having an external cylindrical wall portion whose diameter is substantially smaller than the interior diameter of said sleeve, and an external annular flange located in position to sealingly engage said interior wall.

2. In a rotary drilling table, Kelly driving mechanism comprising a table element formed with a central, upwardly opening recess and a vertical aperture in communication with the recess, means supporting the element for rotation about a vertical axis, a driving bushing positioned in said recess and having a central opening through which a kelly may be slideably extended, said bushing being engageable with the kelly in said opening and with said element to cause the kelly to rotate with the element, said element having peripherally spaced pockets opening inwardly through the side walls of said recess below the top of the element, a seal forming member surrounding

the kelly in said element in position to form a seal between the kelly and element, retainer means in said element in position to engage said member and including means engageable with said element in said pockets to hold the retainer means and member against outward movement in the element, said element also having vertical grooves in said side walls extending upwardly through the top of the element and in communication with said pockets and external lugs on said bushing positioned to enter said grooves.

3. In a rotary drilling table, Kelly driving mechanism comprising a table element formed with a central upwardly opening recess and a vertical aperture in communication with the recess, a tubular sleeve carried by said element in concentric relation to said opening, means for supporting said element for rotation about a vertical axis, seal forming means positioned in the sleeve and having an opening disposed in concentric relation to the sleeve and through which a kelly may be extended, said seal forming means being shaped to form a seal between the kelly and sleeve, said element having peripherally spaced pockets opening inwardly through the side wall of said recess below the top of the element and vertical grooves in said side walls extending upwardly through the top of said element and in communication with said pockets, an annular retainer member in the recess above said seal forming means and having external lugs extending into said pockets, a driving bushing positioned in said recess above said member and having a central opening through which the kelly extends, said bushing being engageable with the kelly in said opening and with said element to cause the kelly to rotate with the element, and means on said bushing positioned to enter said grooves to close the grooves when the bushing is in the recess.

4. In a rotary drilling table, Kelly driving mechanism

comprising a table element formed with a central upwardly opening recess and a vertical aperture in communication with the recess, a tubular sleeve carried by said element in concentric relation to said opening, means for supporting said element for rotation about a vertical axis, a tubular seal forming member supported on said element extending into the sleeve in surrounding relation to and in sealing engagement with a kelly extending through the sleeve and having a cylindrical external wall portion of smaller external diameter than the internal diameter of the sleeve and an external, annular, downwardly cupped flange mediate the ends of the member in position to sealingly engage the interior of the sleeve, said element having peripherally spaced pockets opening inwardly through the side wall of the recess below the top of the element and vertical grooves in said side walls extending upwardly through the top of said element and in communication with said pockets, an annular retainer member in the recess above said seal forming means and having external lugs extending into said pockets, a driving bushing positioned in said recess above said retainer member and having a central opening through which the kelly extends, said bushing being engageable with the kelly in said opening and with said element to cause the kelly to rotate with the element, and means on said bushing positioned to enter said grooves to close the grooves when the bushing is in the recess.

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