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3,297,091

ROTATING GAS DRILLING HEAD

Original Filed June 7, 1963

2 Sheets-Sheet 1

FIG. 1.

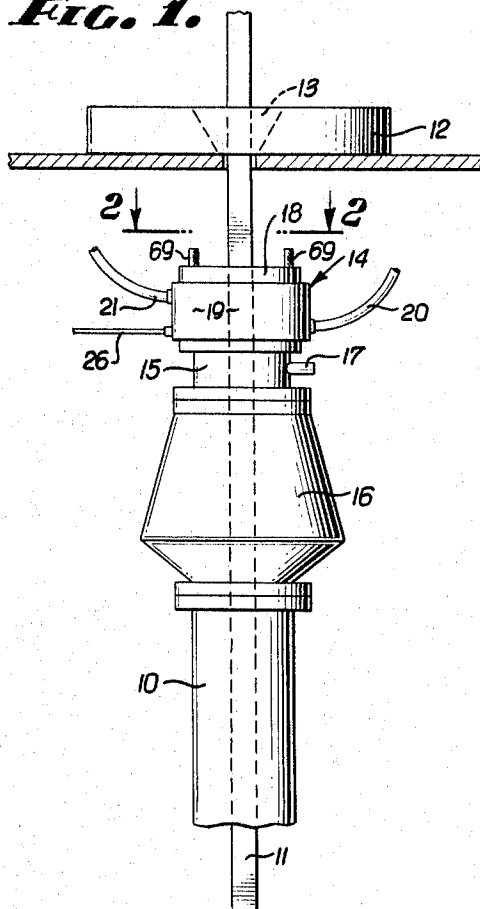


FIG. 2.

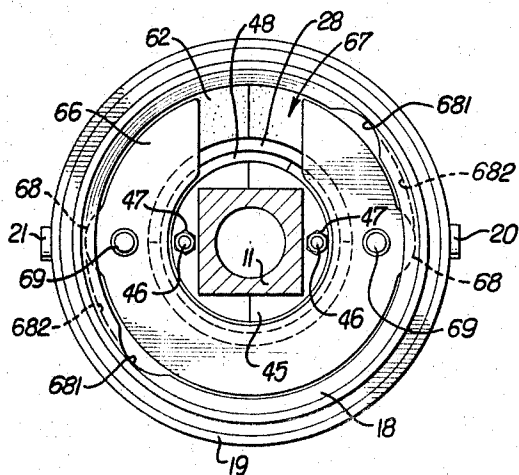


FIG. 4.

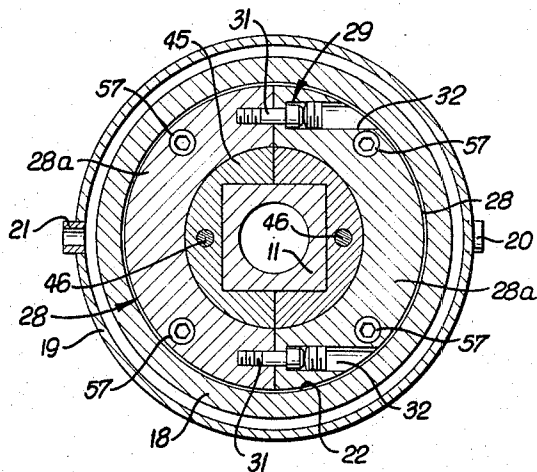
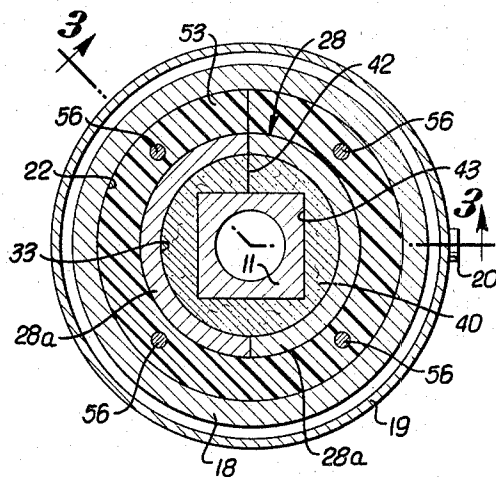


FIG. 5.



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FIG. 3.

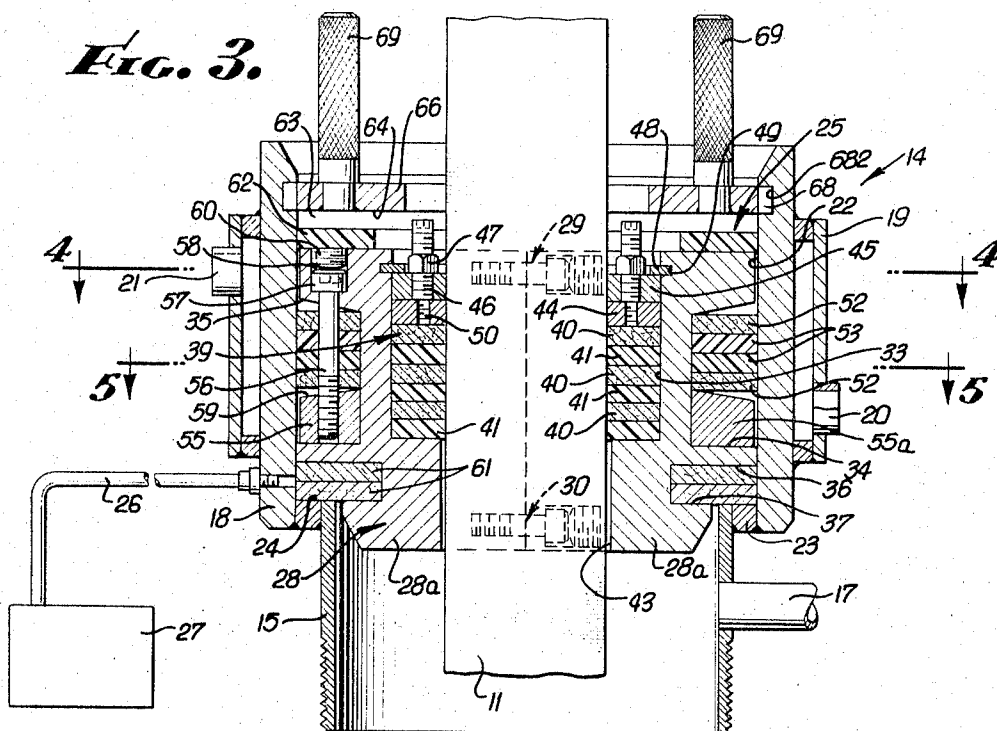
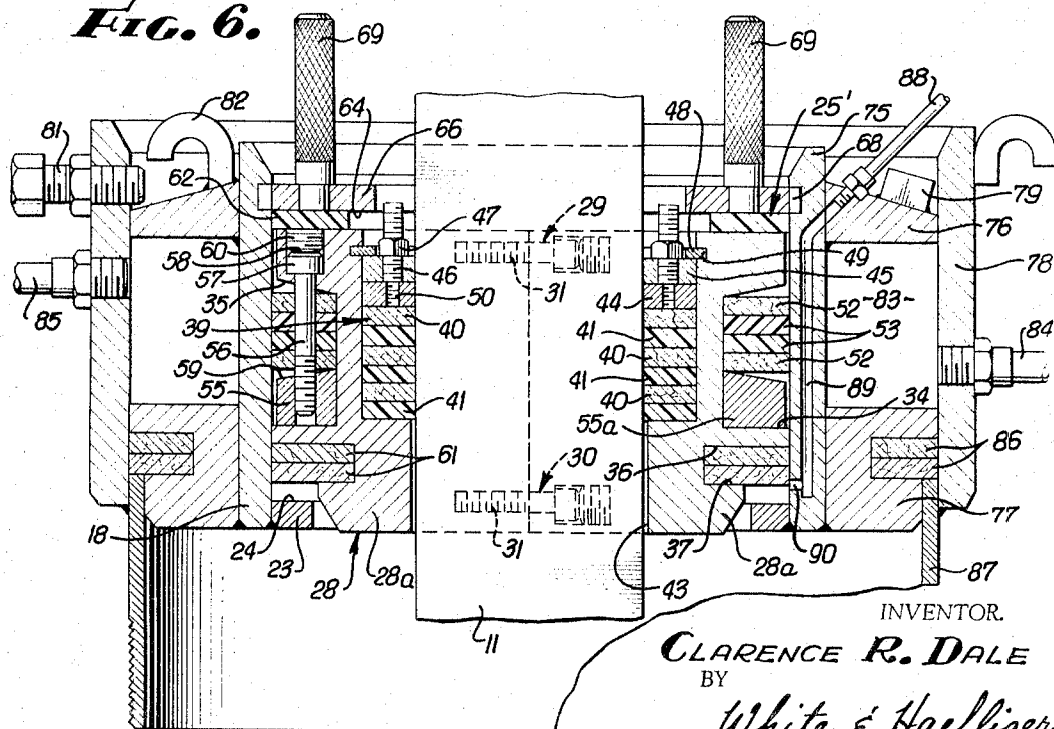


FIG. 6.



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ROTATING GAS DRILLING HEAD

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Continuation of abandoned application Ser. No. 286,352,
June 7, 1963. This application June 30, 1965, Ser.
No. 470,332

14 Claims. (Cl. 166—84)

The present application is a continuation of my application Serial Number 286,352, filed June 7, 1963 on "Rotating Gas Drilling Head" and now abandoned.

This invention has to do generally with improvements in casing head assemblies especially adapted for use in the drilling of wells by the use of air or other gases (all of which are intended to be inclusive in the term "gas") which is maintained under circulation down through the drill string to a bit or other cutting tool, for return flow with entrained cuttings to the ground surface.

More particularly, the invention is directed to a novel head structure designed with the objectives of maintaining very simple and effectively, seals against consequential leakage about the drill string of pressurized gas introduced to the well and casing, and further to the practical end that by reason of its simple structure and serviceability, the drilling head may be manufactured and maintained at exceptionally low costs.

Gas drilling is practiced using a drill string having a top polygonal or kelly section rotatable as by a conventional table positioned above the casing head assembly. The present invention contemplates maintenance of a gas scape seal about the kelly, and in a manner significantly differing from conventional practices of attempting seal maintenances by the use of contractive but otherwise relatively stationary packers about the drill string or kelly. Such conventional packing heads are found to perform less efficiently and to involve far greater expense than the present simplified form of head.

Structurally, the invention contemplates a gas drilling head comprising a body positionable about the kelly above the casing as between a rotary table and blowout preventer, the drilling head body containing a packing assembly having a kelly-passing opening, and characterized in the respects of being both rotatable by the kelly, and displaceable by the casing gas pressure longitudinally thereof, to constitute in effect a floating unit which maintains seals against both the kelly and wall of the body. The packing assembly is further characterized as being applicable to and removable from the kelly by virtue of split or sectional construction as later described.

In particular reference to the packing assembly, the invention has for its object to provide a metallic holder apertured in accordance with the cross sectional configuration of the kelly, and carrying correspondingly oriented packing which engages and seals about the kelly. The holder also mounts packing which engages against the inside wall of the head body to maintain a second annular seal. As will appear, the packing assembly has such exposure to the casing gas pressure, as to be displaceable upwardly thereby in the head, the displacement range being predetermined by spaced stop shoulders or surfaces against which the assembly is rotatable. By reason of the consequent pressure floatation given the packing assembly during operation, all functional and sealing surfaces in the head are relieved of any loads or pressures that could result in excessive wear. As a consequence, the head is capable of long service without necessary or expensive replacements or repairs.

Further objects of the invention have to do more particularly with certain details of the packing assembly construction. As to these features, the invention contemplates split formation of the packing holder for lateral

application to and removal from the kelly, and its design in a manner capable of accommodating sectional or split annular packing segments in the inside and about the kelly, as well as similarly formed packing segments at the outside adjacent the body wall. In this manner it is made possible to employ packing of readily available and inexpensive form and materials, which can be easily assembled and replaced.

Serviceability of the head is further enhanced by the provision of means for introducing lubricant to the head at one or more locations assuring lubrication of friction surfaces against which the packing rotates.

The invention further contemplates accommodation about the kelly of a packing assembly as previously characterized, in a manner capable of removal to permit withdrawal from the well of larger size tools or bits, where an outer body containing the seal is adequately sized to pass the tools, but may be oversized beyond requirements of the seal assembly, or of a smaller or more standard seal and body assembly usable with smaller tools. Generally, the invention contemplates adapter accommodation of a smaller seal body within an outer enlarged body or shell, so that the former may be removed for tool passage through the outer body.

All the various features and objects of the invention, as well as the details of illustrative embodiments thereof, will be more fully understood from the following detailed description of the accompanying drawings in which:

FIG. 1 is a diagrammatic showing of the drilling head in a typical association with a rotary table and blowout preventer;

FIG. 2 is a plan view of the drilling head as taken;

FIG. 3 is a view showing the drilling head in vertical section, but taken in the broken plane 3—3 of FIG. 5 to show one of the outer packing adjustment screws;

FIGS. 4 and 5 are reduced scale cross sections taken respectively on lines 4—4 and 5—5 of FIG. 3; and

FIG. 6 is a view similar to FIG. 3 showing a variational form of the invention.

FIG. 1 is illustrative of a typical arrangement for air drilling, according to which the tubular drill string carrying at its lower end a drill bit, is run down through the casing 10. The drill string includes the usual top kelly section 11 whereby the string is rotated by the usual rotary table 12 having bushings 13 which pass and engage the polygonal cross section kelly. The invention is concerned with the drilling head generally indicated at 14 shown to be positioned above and connected by nipple 15 with a blow-out preventer 16 which may be of any appropriate type. During drilling pressurized gas is discharged down through drill string and bit to entrain cuttings which are carried upwardly through the casing and blow-out preventer to be discharged at 17. As previously indicated, the general function of the head 14 is to maintain during drilling a rotating seal against escape of gas which ordinarily may be pressurized within the casing upwardly of 100 p.s.i.

Referring now to FIG. 3, the head 14 shown to comprise a tubular body 18 to which, if desired, may be applied an annular jacket 19 for circulation therethrough, from an inlet 20 to an outlet 21, of cooling fluid for dissipation of heat from the body, created internally by packing rotation against the inner surface 22 of the body seal. The latter is shown to contain a bottom welded ring 23 flush with the top of nipple 15 to present at 24 a supporting surface for the internal packing assembly generally indicated at 25. Suitable provision may be made for supplying lubricant to and along the internal body surface 22 to minimize frictional resistance to packing rotation, as by way of hose or line 26 through which lubricant from a constant supply source diagrammatically indicated at 27, is delivered into the head so as to com-

pletely film the body surface 22 by virtue of the packing assembly rotation and its vertical displacement.

The packing assembly 25 is shown to comprise a metallic holder 28 formed in diametrically split sections 28a, see FIG. 4, applicable laterally about the kelly 11 and releasably held together by upper and lower pairs 29 and 30 of screws 31 set into counterbores 32 in section 28a. As viewed in FIG. 3, the holder 28 has an internal recess in the form of a counterbore 33, an outer recess vertically defined by holder 34 and angular or wedge holder 35, and the bottom recess between surfaces 36 and 37. It will be observed that the bottom of the packing assembly 25 is exposed to the casing or nipple 15 gas pressure, allowing for upward displacement of the assembly, as will later appear. Below the counterbore 33, the holder 28 has a polygonal or essentially square opening 38 in conformance with the cross sectional configuration of the kelly so that during drilling, the kelly rotation is imparted to the holder 28 and therefore to the packing assembly.

Recess 33 contains suitable packing, generally indicated at 39, for engaging and sealing about the kelly, the packing advantageously, though typically, being in the form of radially split rings of belting 40 alternating with correspondingly split neoprene rings 41. These packing rings, preferably formed with a single split at 42 (although if desired they may be diametrically split), may be applied laterally about the kelly, and by reason of their split configurations, are adapted for easy replacement or inspection. As shown in FIG. 5, the packing 39, like the holder 28, has a square configuration at 43 in conformance with the kelly. The packing assembly 39 is compressible longitudinally of and against the kelly by a ring 44 which in turn is thrust downwardly by screws 46 threaded through the ring 45 and carrying retaining nuts 47. Ring 45 is held in place by snap ring 48 snapped into the recess 49. Ring 44 may be provided with threaded openings 50 to receive a tool for removal of the ring from bore 33.

The outer holder recess is shown to contain belting and neoprene packing rings 52 and 53 split in the manner of rings 40 and 41 to be insertible within and removable from the recess. This packing is compressible longitudinally of the holder and expansible outwardly against the body surface 22, by a ring 55 composed of sections 55a split like the holder and receiving screws 56 having heads 57 accommodated within counterbores 58 in the top of the head. Upon rotation of the screws, the ring sections 55a are brought upwardly against the packing, compressing the latter between the angular ring and holder surfaces 59 and 35 to compress and expand the packing. The screws are held in adjusted positions by tubular stop nuts 60 through which a driver may be inserted for adjustment of screws 56.

The bottom holder body recess receives between shoulders 36 and 37 a pair of split belting rings 61 which have a sealing function in relation to the body surface 22 and also provide reduced friction support for the packing assembly upon surface 24. A split neoprene ring 62 is carried on the top surface of the packing holder 28, and normally, or in the inactive state of the head, is spaced at 63 below a stop surface 64 presented by the underside of a retaining ring 66. Referring to FIG. 2, the retaining ring is shown to have at 67 a gap sufficiently wide to permit placement of the ring about the kelly, the ring carrying circularly spaced lugs 68 which are insertible through openings 681 into grooves 682 wherein the lugs are rotatable using the ring handles 69 to the dotted line positions to releasably retain the ring within the body 18. Thus the ring serves as a retainer against upward displacement of the packing assembly 25 out of the body, and it also serves as a stop to limit upward displacement of the packing assembly under the influence of bottom gas pressure during drilling.

In operation, and assuming the packing holder 28 and

the associated split packing and other ring parts to be assembled about the kelly and within the body 18 according to FIG. 3, rotation of the kelly is imparted to the packing assembly, and the latter is displaced upwardly by the gas pressure below, so that the non-metallic ring 62 engages and rotates against the stop surface 64. In normal operations, the gas pressure exerted upwardly against the assembly will not be of sufficient magnitude to create severe wearing condition in the interengagement of the ring 62 with surface 64. But in any event, the ring is easily replaceable. Lubricated engagement of the outer packing against the body surface maintains an effective seal throughout rotation, against consequential gas leakage about the assembly 25, while the inner packing 39 similarly seals against consequential leakage about the kelly.

Under some circumstances it may be desirable to utilize a drill bit of larger size than could be passed through a body 18 whose diameter has been determined only from a standpoint of accommodating the internal packing assembly. Since, for sealing purposes, the diameter of the body may advantageously be kept relatively smaller, and it may be more practicable to stock smaller diameter head assemblies corresponding to FIG. 3, for all uses and drill bit sizes, provision may be made according to FIG. 6, for adapting a standard size drilling head to an outer body sized to afford larger area for tool passage. Here the threading head body 75 has welded to it upper and lower liner or adapter rings 76 and 77 which are received within an enlarged outer body 78, ring 76 carrying a key 79 engageable against screw 81 to prevent rotation of the packing head assembly within the body 78. Upward displacement is prevented by set screw 81, and ring 76 may be provided with one or more lifting hooks 82 for use in removal of the head and ring assembly from the body. The latter contains an annular space 83 through which coolant may be circulated from inlet 84 to outlet 85. Ring 77 contains split packing rings 86 which seat against the upper end of the nipple 87. Thus the bodies 75 and 78 remain stationary during drilling. Here, lubricant is shown to be fed under constant pressure to the packing assembly 25' by way of line 88 connecting with passage 89 in the wall of body 75 and discharging at 90 about the packing assembly in the manner of line 26 in FIG. 3.

The packing assembly structure corresponds to that previously described with reference to FIG. 3, and accordingly, corresponding parts are given the same reference numerals.

I claim:

1. A gas drilling head for well casing and adapted to receive a polygonal cross section kelly extent of a drill string through which pressurized gas is introduced to the well and casing, comprising a tubular stationary body including means for attachment to the casing, a metallic tubular diametrically split packing holder within said body and exposed to casing pressure inside the bottom of the body, said holder having a polygonal kelly-passing opening extending therethrough coaxially of the body and having such size that the holder is rotatably driven by the kelly, packing means carried by the inside and outside of said holder for rotation therewith and having sealing engagement with the kelly and body wall, said holder and packing being movable up and down relative to both the body and kelly, stop means carried by the body and normally spaced above the holder and packing whereby the holder and packing are simultaneously rotatable in the body and upwardly displaceable therein by the casing gas pressure.

2. A drilling head according to claim 1, in which packing means is of substantially annular form and is split radially of the holder.

3. A drilling head according to claim 2, in which said holder has a central cavity and an outer surrounding recess containing a portion of said packing means.

4. A drilling head according to claim 3, in which said

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packing means comprise packing layers in substantially annular radially split form.

5. A drilling head according to claim 4, including also means carried by said holder and adjustable to press said packing means against the kelly and body wall.

6. A drilling head according to claim 4, in which said stop means comprise a ring removably received within the upper interior of the body and serving to retain said holder and packing means therein and to arrest upward displacement of the holder.

7. A drilling head according to claim 4, including also means forming stop shoulders in the body above and below the holder and packing means at spacing greater than the axial dimension of the holder and packing means and operable to limit their up and down displacements.

8. A drilling head according to claim 1, in combination with an outer relatively large diameter body containing and spaced about the first mentioned body, and means stationarily supporting said first mentioned body within the outer body.

9. A drilling head according to claim 8, in which said supporting means comprise vertically spaced rings on the outside of said first mentioned body and engaging the inside of the outer body, and means releasably retaining the first mentioned body and said rings in the outer body.

10. A gas drilling head for well casing and to receive a polygonal cross section kelly extent of a drill string through which pressurized gas is introduced to the well and casing, comprising a tubular stationary casing head body having an interior to receive casing pressure, and a casing pressure responsive packing device within said body and comprising a metallic tubular essentially cup-shaped diametrically split packing holder having a polygonal kelly passing opening and rotatable in said body by the kelly, first annular packing means carried inside said holder and having a polygonal kelly passing opening coaxial with the body, second annular packing means carried at the outside of said holder, both said packing means being split to be applicable laterally respectively about the kelly and holder, the packing being operable during drilling by rotation of the kelly to pass and seal against

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the surfaces of the kelly and also to engage and seal against the inside surface of the stationary body, said packing device being movable up and down relative to the body and kelly, stop means carried by the body and normally spaced above said device, said device being accommodated for vertical floating movement within the body in the respect of being displaceable upwardly against said stop means in response to casing pressures whereby said device is simultaneously rotatable and axially shiftable within the body.

11. A drilling head according to claim 10, in which said body contains means forming vertically spaced stop surfaces spaced apart above and below said device a distance greater than the axial dimension of said device whereby said surfaces are alternately and rotatably engageable by said packing device at the extremities of its axial displacement.

12. A drilling head according to claim 10, in which said packing holder comprises screws interconnecting its diametrically split sections.

13. A drilling head according to claim 10, in which said holder has metal-to-metal driven contact with the kelly below said packing means.

14. A drilling head according to claim 10, in which said stop means comprises a ring removably received within the upper interior of said body and serving to retain the packing device therein.

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