April 9, 1929. J. W. MacCLATCHIE 1,708,316

BLOW-OUT PREVENTER

Filed Sept. 9, 1926 2 Sheets-Sheet 1

Fig. 3.

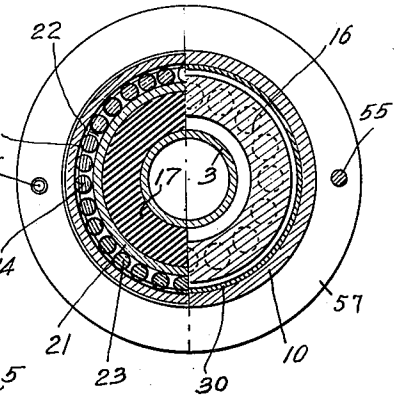

Fig. 1.

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Filed Sept. 9, 1926 2 Sheets-Sheet 2

Fig. 2.

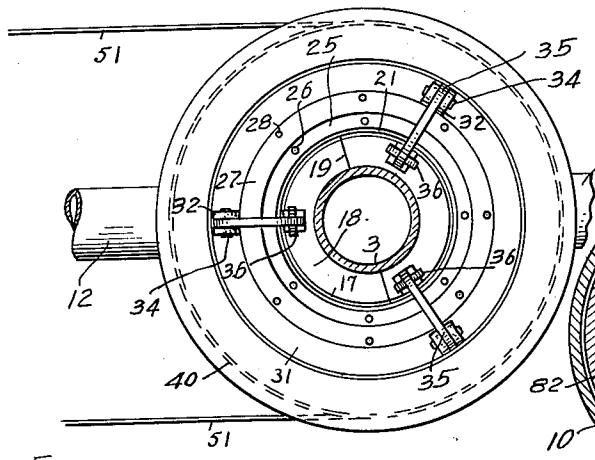


Fig. 8.

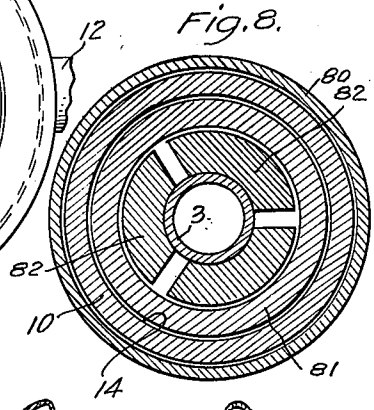


Fig. 5.

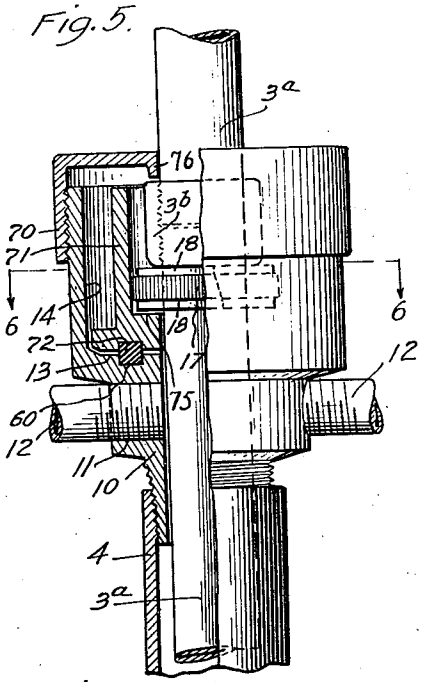


Fig. 7.

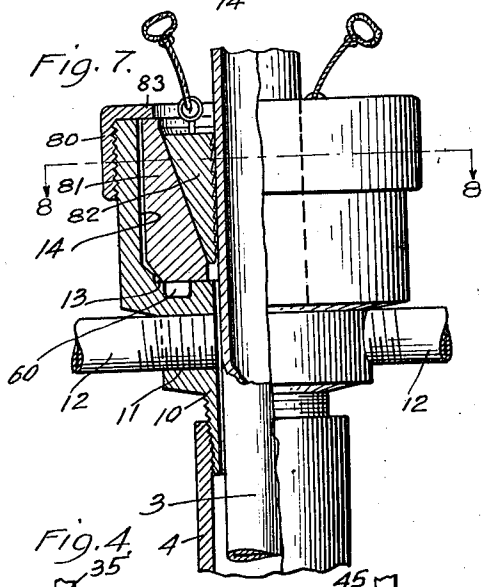


Fig. 6.

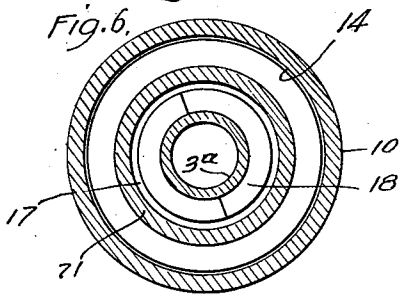
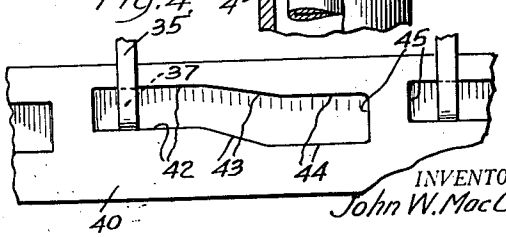


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOHN W. MacCLATCHIE, OF COMPTON, CALIFORNIA.

BLOW-OUT PREVENTER.

Application filed September 9, 1926. Serial No. 134,391.

This invention is a means for preventing blowing-out of wells by providing for usual operation of a rotary drill pipe while positively packing-off between the drill pipe and the well casing; and it is the object of the invention to conserve the packing medium by relieving it of the weight of the string of drill pipe, and to expand the packing to operative position by any excessive pressure which might develop in the well.

It is a further object of the invention to provide anti-frictional means between the rotating and the stationary elements of the device, and to arrange the anti-frictional means so as to adequately provide for both end and lateral thrust and thereby insure operation with minimum frictional resistance and provide an extremely durable construction.

It is a still further object of the invention to positively retain the drill pipe and its associated rotatable elements in packed-off relation to the well casing, and to secure and release the retaining means with minimum effort and expenditure of time.

It is a still further object of the invention to provide a blow-out preventer which by substitution of interchangeable parts will readily form either a spider for use in pulling strings of drill pipe or a packing head for use on a well which is on production.

Further objects of the invention will be readily understood from the following description of the accompanying drawings, in which:

Fig. 1 is a front elevation of the blow-out preventer, partly in axial section, and showing the same in operative position with relation to a well rig.

Fig. 2 is a top view of the blow-out preventer.

Fig. 3 is a transverse section on the line 3—3 of Fig. 1.

Fig. 4 is a diagrammatic showing of the cam operating means.

Fig. 5 is a front elevation, partly in axial section, showing the use of the device as a packing head.

Fig. 6 is a transverse section on the line 6—6 of Fig. 5.

Fig. 7 is a view similar to Fig. 5 showing use of the device as a spider.

Fig. 8 is a transverse section on the line 8—8 of Fig. 7.

The invention is illustrated in connection with a usual rotary drilling apparatus which is mounted in a well rig including derrick floor 1 and the usual cellar 2. Drill pipe 3 in the well casing 4 projects upwardly from the casing through the derrick floor and is engaged by the usual rotary table 5. One of the cat-heads of the draw works for the rotary table is shown at 6, the draw works and the rotary table having the usual driving connections (not shown).

The blow-out preventer is mounted in the cellar 2 beneath the derrick floor, and comprises an annular shell 10 threaded onto the upper end of well casing 4 and surrounding the drill pipe 3. The shell is provided with T-couplings 11 for connecting the usual circulating pipes 12, and above the couplings 11 the shell flares to an increased diameter forming an end seat 13 and a lateral bearing surface 14.

A ball race 16 is mounted in shell 10 on the seat 13, and packing means which is mounted on the drill pipe 3 abuts against the upper cage of the ball race. The packing means, which has a bore adapted to fit snugly on the drill pipe, comprises an expandible sleeve 17 of rubber or the like provided with end rings 18 of wear resisting material such as a suitable metal, and the packing means is preferably diametrically split as shown at 19 so that it may be readily mounted on the drill pipe.

The outer periphery of the packing is spaced from bearing surface 14, and a sleeve 21 is mounted in this space with the packing 17 expandible against its inner periphery and its outer periphery flanged as shown at 22 to form retaining means for roller bearings 23 which provide an anti-frictional engagement between sleeve 21 and the bearing surface 14. By this arrangement, axial compression of the packing 17—18 against the ball race 16 is adapted to radially expand the packing so that it tightly engages the drill pipe 3 and the sleeve 21, thereby providing a fluid tight connection between the pipe and sleeve, and causing rotation of the sleeve with the pipe and packing, with the rotating elements provided with both end and lateral anti-frictional bearings by means of ball race 16 and roller bearings 23.

In addition to the packing between the rotatable sleeve and the drill pipe, the sleeve is packed-off relative to the station-

ary shell 10 to provide an absolutely fluid tight closure between the drill pipe and the well casing; and in order to eliminate excessive wear of this additional packing medium which is between rotating and non-rotating elements, the packing is only expanded into fluid tight engagement with said elements when the pressure in the well is such as to tend to cause a blow-out.

As an instance of this arrangement the packing is shown as cup packing 24 fixed to the ends of sleeve 21 by retaining rings 25 which may be bolted to the sleeve as shown at 26; and the sleeve 21 and its associated parts may be retained in shell 10 by a ring 27 bolted to the upper end of the shell as shown at 28, and overlying the upper retaining ring 25 at its inner periphery. The cup-shaped peripheral flanges 30 of the packing extend downwardly along the bearing surface 14 and are expanded to tight packing engagement therewith by the pressure in the well casing; and as a consequence the assembled structure completely packs-off between the well casing and the drill pipe, while permitting usual operation of the drill pipe and eliminating excessive wear of the parts.

Means are provided for locking the parts in assembled relation and axially compressing the packing 17 for radial expansion to operative position; and for this purpose a sleeve 31 is threaded onto the upper end of shell 10, and is provided with circumferentially spaced pairs of lugs 32 between which bell-crank levers are pivoted on pins 34. Arms 35 of the bell-crank levers curve inwardly over the upper end of shell 10 and sleeve 21 into axial alinement with the packing 17—18, and rollers 36 journaled in the ends of the arms provide anti-frictional contact with the upper ring of the packing.

The opposite ends 37 of the bell-crank levers project radially and are adapted to be dependently swung for shifting arms 35 so as to release packing 17—18 or axially compress it against the ball race 16; and the means for dependently swinging the levers is adapted to lock the arms 35 in either their engaged or released position.

For this purpose an annulus 40 is rotatable on a flange 41 of sleeve 31, and the inner periphery of the annulus forms cam surfaces cooperating with the respective arms 37. The cams for each arm comprise cam surfaces vertically spaced to receive the arm between the same, and the cam surfaces extend horizontally as shown at 42, and are then inclined as shown at 43 to terminate horizontally as shown at 44. Rotation of annulus 40 in opposite directions will thus cause the arms 37 to ride up or down the inclined surfaces 43 for swinging the bell-crank levers to raise or lower arms 35; and the arms 37 are held between the horizontal surfaces 42 or 44 to lock the bell-crank levers when arms 35 are either raised or lowered.

Abutments 45 are provided at the ends of the cams, so that when annulus 40 has been rotated until the arms 37 engage one or the other of their end abutments, continued turning of the annulus will correspondingly rotate sleeve 31 and will thus screw the latter up or down at its threaded connection with shell 10. The clamping engagement of rollers 36 against the packing 17—18 may thus be tightened, or the sleeve 31 may be disengaged from shell 10 to permit disassembly of the device.

The annulus 40 is preferably adapted to be rotated by the power drive of the well drilling apparatus; and for this purpose the outer periphery of the annulus forms a pair of grooves 50, and cables 51 are fixed to the annulus and extend around the same in opposite directions in the respective grooves. The ends of the cables are guided over pulleys 52 through the derrick floor 1 to a position adjacent the cat-head 6 which is rotated by the drive mechanism, so that when a bight of one cable or the other, depending upon the direction in which it is desired to turn annulus 40, is snubbed around the rotating cat-head, the annulus is turned in the desired direction by the power drive.

In operation, the packing 17—18 rotating with the drill pipe 3 might tend to rotate sleeve 31 after it had been screwed to the desired adjusted position, and to prevent this possibility the sleeve 31 may be locked in adjusted position by bolts 55 which are threaded through a flange 57 of the shell 10 so as to engage the flange 41 of sleeve 31. The bolts may be held in set position by lock nuts 56.

By substituting interchangeable parts, the structure as thus described may be adapted for use as a packing head for the casing of a well which is on production, the packing medium 17—18 being mounted on the well tubing 3^a beneath one of the tubing couplings 3^b, and the sleeves 21 and 31 and their associated parts being removed from the shell 10. A sleeve 71 is mounted in shell 10 on seat 13 and forms an abutment 75 for the lower ring of packing 17—18, and this sleeve is packed-off relative to the shell by annular packing 72 which projects beyond the lower end of the sleeve and is received in a groove 60 in the seat 13. Packing 17 is radially expanded to provide a fluid tight connection between sleeve 71 and the well tubing by axially compressing the packing between coupling collar 3^b and the abutment 75; and the means for axially compressing the packing also positively locks the parts in assembled relation and expands the packing 72.

As an instance of this arrangement a collar 70 may be threaded onto the upper end

of shell 10 with a flange 76 of the collar extending over the upper ends of shell 10 and sleeve 71 and abutting against the coupling collar 3^b of the well tubing. Screwing the collar downwardly on shell 10 will thus axially compress packing 17—18 between coupling collar 3^b and abutment 75 and will also depress sleeve 71, so that packing 17 and 72 are expanded to operative position for completely packing-off between the well casing and tubing, and all of the parts are held against displacement.

By further substitution of interchangeable parts the shell 10 may form a spider for drill pipe 3; and in this case an annulus 81 having a downwardly converging tapering bore is mounted in shell 10 on seat 13, and slips 82 are adapted to be wedged in the bore of the annulus so that the teeth of the slips engage the drill pipe for supporting the same in usual manner. The annulus 81 may be fixed in the shell 10 by a collar 80 which is threaded on the upper end of the shell and forms a flange 83 which overlies the upper end of the annulus for abutment therewith.

I claim:

1. A device of the character described adapted for use in connection with well apparatus, comprising a shell adapted for mounting on a well casing, said shell forming an end bearing seat and a lateral bearing surface, packing adapted to snugly engage a drill pipe rotatable in the well casing, an anti-frictional axial abutment between the packing and the end bearing seat of the shell, a sleeve in the shell engaging the packing, roller bearings between the sleeve and the lateral bearing surface of the shell, cup-packing at the end of the sleeve expanded to operative engagement with the lateral bearing surface of the shell by pressure in the shell, an annulus threaded on the shell, a member pivoted to the annulus, an anti-frictional engagement between the pivoted member and the first mentioned packing adapted to axially compress said packing so as to radially expand the same to operative position by swinging said pivoted member, a cam rotatable on the annulus engaging the pivoted member to swing and lock the same in operative or inoperative position, a cable for rotating the cam adapted for operative engagement by the power drive of the well apparatus, an end abutment between the cam and the pivoted member adapted to rotate the annulus with the cam after the pivoted member is locked in operative or inoperative position, said rotation of the annulus adjusting its threaded connection on the shell, and means for locking the annulus in threaded adjusted position relative to the shell.

2. A device of the character described adapted for use in connection with well apparatus, comprising a shell adapted for mounting on a well casing, packing adapted to snugly engage a drill pipe which is rotatable in the well casing, means adapted for rotation in the shell and engagement by the packing to provide a fluid tight connection between the drill pipe and rotatable means, anti-frictional end and lateral bearings for the rotatable means in the shell, packing between the rotatable means and the shell adapted for expansion to operative position by pressure in the shell, anti-frictional contact means for compressing the first mentioned packing to operative position, and means for locking or releasing said compressing means adapted for actuation by the power drive of the well apparatus.

3. A device of the character described comprising a shell adapted for mounting on a well casing, said shell forming an end bearing seat and a lateral bearing surface, means rotatable with a drill pipe in the well casing for packing-off between the drill pipe and the shell, and anti-frictional bearings between said rotatable means and the end bearing seat and the lateral bearing surface of the shell.

4. A device of the character described adapted to pack-off between a well casing and a rotatable drill pipe, comprising a shell on the well casing, packing on the drill pipe, a cooperating abutment for the packing rotatable in the shell, and means for packing-off between said abutment and the shell adapted for expansion to operative position by pressure in the shell.

5. A device of the character described comprising a shell adapted for mounting on a well casing, packing adapted to snugly engage a drill pipe which is rotatable in the well casing, means engageable by the packing and rotatable in the shell, a member pivoted relative to the shell and adapted to engage the packing for axially compressing the same to radially expanded operative position by swinging the pivoted member, and a cam adapted to engage the pivoted member for swinging and locking the same in operative position.

6. A device of the character described comprising a shell adapted for mounting on a well casing, packing adapted to snugly engage a drill pipe which is rotatable in the well casing, means engageable by the packing and rotatable in the shell, and a member mounted on the shell and having an anti-frictional engagement with the packing for axially compressing the same to radially expanded operative position.

7. A device of the character described comprising a shell adapted for mounting on a well casing, packing adapted to snugly engage a drill pipe which is rotatable in the well casing, means engageable by the packing and rotatable in the shell, an annulus

threaded on the shell, a member pivoted to the annulus adapted to engage the packing for axially compressing the same to radially expanded operative position by swinging movement of the pivoted member, a cam rotatable on the annulus engaging the pivoted member for swinging the same, and an end abutment between the cam and the pivoted member adapted to rotate the annulus with the cam after the pivoted member is swung, said rotation of the annulus adjusting its threaded connection on the shell.

8. A device of the character described adapted for mounting on a well casing, packing adapted to engage a drill pipe which is rotatable in the well casing, rotatable retaining means for the packing, non-rotatable means for compressing the packing and locking the same relative to the rotatable drill pipe and retaining means, and anti-frictional means between the rotatable and non-rotatable means.

9. A device of the character described adapted for mounting on a well casing, packing adapted to engage a drill pipe which is rotatable in the well casing, rotatable retaining means for the packing, means independent of the rotatable retaining means for compressing the packing and locking the same relative to the rotatable drill pipe and retaining means, and anti-frictional means between said rotatable retaining means and said independent means.

10. A device of the character described comprising a shell adapted for mounting on well casing, a rotatable retaining means in the shell, packing between the rotatable retaining means and a drill pipe which is rotatable in the well casing, anti-frictional end and lateral bearings between the rotatable retaining means and the shell, and packing between the rotatable retaining means and the shell.

11. A device of the character described comprising a shell adapted for mounting on well casing, a rotatable retaining means in the shell, packing between the rotatable retaining means and a drill pipe which is rotatable in the well casing, anti-frictional end and lateral bearings between the rotatable retaining means and the shell, and packing between the rotatable retaining means and the shell adapted for expansion by pressure in the shell.

12. A device of the character described adapted for mounting on well casing and comprising packing adapted to engage a drill pipe which is rotatable in the well casing, rotatable lateral retaining means for the packing, non-rotatable means independent of the lateral retaining means for compressing the packing, and anti-frictional means between the rotatable and non-rotatable means.

13. A device of the character described adapted for mounting on well casing and comprising packing adapted to engage a drill pipe which is rotatable in the well casing, rotatable retaining means for the packing, non-rotatable means for compressing the packing, and anti-frictional means between the rotatable and non-rotatable means.

14. A device of the character described adapted for mounting on well casing and comprising packing adapted to engage a drill pipe which is rotatable in the well casing, means for compressing the packing, and a cam rotatable to shift the compression means to operative or inoperative position.

15. A device of the character described adapted for use in connection with well apparatus and comprising packing adapted to engage a drill pipe which is rotatable in well casing, a pivoted member adapted to engage the packing for compressing the same, and means for swinging the pivoted member to operative or inoperative position adapted for actuation by the power drive of the well apparatus.

16. A device of the character described comprising a shell adapted for mounting on well casing, packing adapted to engage drill pipe which is rotatable in the well casing, means for compressing the packing, an annulus threaded on the shell, a cam rotatable on the annulus for actuating the compression means, and an end abutment between the cam and the compression means adapted to rotate the annulus after the compression means has been moved to operative position, said rotation of the annulus adjusting its threaded connection on the shell.

In testimony whereof he has affixed his signature to this specification.

JOHN W. MacCLATCHIE.