

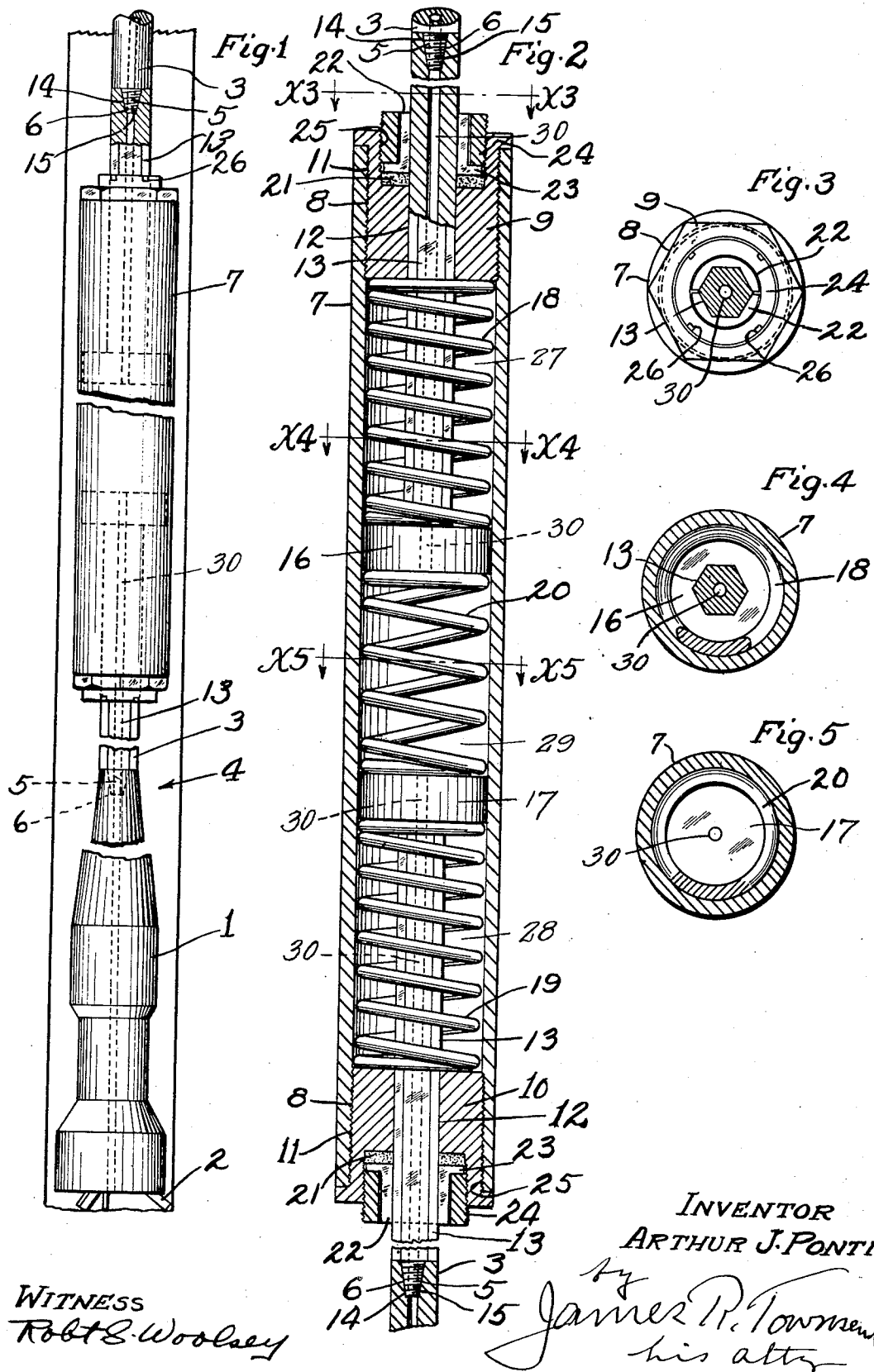
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STRESS AND STRAIN COMPENSATING JOINT FOR ROTARY WELL DRILLING COLUMNS

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## UNITED STATES PATENT OFFICE

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## STRESS AND STRAIN COMPENSATING JOINT FOR ROTARY WELL-DRILLING COLUMNS

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This invention relates to a device applicable to the tubular columns of rotary well-drilling apparatus.

In southern California oil wells are drilled by rotary rigs to great depths, there being many oil producing wells over six thousand feet in depth, and a number of wells ranging from six thousand five hundred feet to eight thousand feet deep.

Such holes are drilled by means of a tubular bit on the lower end of a tubular drill stem or column that is rotated in the hole while there is pumped down through the column and the bit, a flow of what is known to the drillers as fluid or liquid rotary drilling mud which is depended upon to remove the drillings from the bottom of the hole and to carry such drillings up outside the drill bit and rotary column to the surface where it is discharged; the flow of such mud being continued so long as the drill is rotated.

The rotary tubular drilling columns for such depths are necessarily ponderous, and very powerful machinery is employed to move them vertically and such movement subjects the machinery, the derrick and the column to great jars, shocks, stresses and strains, likely to cause breakage of the machinery, and the column, and to rack and break the derrick, and great expense and loss of time for repairs is likely to be imposed thereby.

Such jars, shocks, stresses and strains are also likely to cause crystallization of the rotary drill column, especially at the joints, whereby such column may give way unexpectedly under comparatively light service.

It has been proposed to interpose in the hollow rotary drill column a joint provided with means for absorbing the shock.

An object of this invention is to provide an anti-collapsing appliance that when interposed in the column, will absorb the shock or will yieldingly transmit the force applied to move the column vertically, and that will make provision whereby the appliance may be installed to operate at any depth required for practical use.

Another object is to so construct the column joint that it will hold the tubular stem sec-

tions in true alinement and free from any wobbling.

In carrying out this invention it is necessary to guard against any likelihood that the hydrostatic pressure on the outside of the joint will collapse the same.

Another object is to make provision whereby any tendency toward the boring of a crooked hole will be neutralized or avoided.

It has been proposed to make a rotary column out of tubular rotary stem sections having a central bore and united by threaded box and pin joints, and in this invention I introduce into such column in relative non-rotating relation, a tubular housing having closed ends, and two stem sections reciprocable through such ends and provided in the housing chamber, with heads separated from each other and from the housing heads by yielding means that will modify the relative axial movement of the heads of the housing and the stem section, and there intercept or modify the shock; and I have interposed springs between the heads of stems and housing for this purpose and for the purpose of resiliently spacing the heads apart to allow requisite reciprocatory movement of the parts without actual contact of the heads, or such abrupt termination of the reciprocatory movement of the parts as would result in a destructive jar either up or down, but to allow application of momentum of the column to loosen a stuck tool from the walls of the hole.

I also provide for a sliding fit between the peripheries of the stem section heads and the bore of the housing, and a like sliding fit of the stems with the housing heads and provide stuffing boxes in the housing heads to prevent leakage of the liquid mud from the housing and provide for flow of mud from spring chamber to spring chamber to accommodate such relative movement of the stem heads as may be required.

By preference, the housing diameter approximates, but is somewhat less than that of the rotary drill bit so that while the housing rotates freely inside the drilled hole, it cannot swing to any great extent without contacting the walls of the hole; and the length of the housing is considerable so that deflec-

tion of the bit from the vertical will be prevented or corrected by contact of the rotating housing with the wall of the hole.

This invention comprises a tubular rotary drilling column provided with axially aligned relatively reciprocable tubular drill stem sections having heads, and a shell non-rotatable relative to the stem sections and provided with a chamber inclosing the headed terminals of the stem sections; means inside the chamber for yieldingly separating the heads from each other and for separating the heads from the ends of the chamber; the bores of said drill stem sections being open to the chamber so that drilling mud may flow through and fill the column and the telescopic joint; and so that hydrostatic pressure of the drilling mud will be applied inside the joint to balance the hydrostatic pressure outside the joint during operation of the drill.

In order to prevent collapse of the joint shell it is necessary that the shell be filled with liquid under hydrostatic pressure corresponding to that in the hole, so that the hydrostatic pressure on the inside of the column will correspond to that on the outside of the column.

An object of this invention is to provide a pressure equalizing, and stress and strain compensating, joint for rotary well drilling columns.

Another object of the invention is to make provision whereby the operation of the drilling apparatus will practically insure a straight hole.

This invention is broadly new, basic and pioneer in that it comprises a coupling shell in combination with two headed telescopic drill stem sections axially aligned therewith and provided with bores opening into the shell, and shock absorbing means to resiliently position the ends of the drill stem and sections with relation to each other and to the heads of the shell.

Advantages incident to the use of the device of my invention are greater ease of tool handling; more even feed of the drilling bit; obviation of breakage the the joints in the pipe column and in the handling mechanism; the ability to "spud" the drill without injury to the drill on pipe column and in the avoidance of pipe bending and crystallization in the joints of the column.

Other objects, advantages and features of invention may appear from the accompanying drawing, the subjoined detailed description and the appended claims.

The accompanying drawing illustrates the invention.

Figure 1 is a fragmental elevation of a drill column constructed in accordance with this invention.

Fig. 2 is an enlarged axial section of the column.

Fig. 3 is a cross section on line  $x^3$ , Fig. 2,

showing the stem, stuffing box and split ring nut.

Fig. 4 is a cross section on line  $x^4$ , Fig. 2.

Fig. 5 is a cross section on line  $x^5$ , Fig. 2.

Arrows on line  $x^3$ ,  $x^4$ , and  $x^5$  indicate the direction of sight.

1 designates the drilling tool, having bits 2, and carried on the lower drill pipe section 3 and operated in a common manner by rotation of the drill pipe or stem from the surface and by forcing water under pressure through the pipe to the point of drilling.

The character 4 in Fig. 1, indicates the lower portion of a hole being drilled by a bit operated by the rotary tubular drill stem made up of sections having pin and box connections as at 5 and 6 in Figs. 1 and 2.

The compensating joint comprises a housing 7 which consists of a length of metallic tubing having internal screw threads 8 at each end to receive the stuffing boxes 9 and 10, the outer peripheries of which include a length, bearing external threads 11 for engagement with the threads 8 of the housing and have their remaining lengths formed octagonal, or otherwise to provide seats for turning, as by a wrench, or similar tool.

Formed axially through each stuffing box is a hole 12 of non-circular contour, such as the hexagon shown, and extended through each stuffing box is a stem 13, sectionally shaped to conform with hole 12 of the stuffing box and dimensioned to freely slide therethrough. The upper end of the stem projecting from the top of the housing is provided with an internally threaded socket 14, similar to the described sockets 6, and the lower end of the stem projecting from the bottom of the housing is provided with a threaded reduction 15, similar to the described reductions 5, whereby the stems may be coupled in the pipe column by box and pin similarly to its several pipe lengths.

Each stem carries at its end within the housing a circular head 16 having a diameter substantially that of the internal diameter of the housing and the stem and head are formed with a continuous passageway 30 for communication with the interiors of the adjoining pipe lengths of the column.

By preference, and as shown, the heads are formed as integral parts of the stems, as by forging or casting.

Interposed between and impinging the stuffing box 9 and the head of the upper stem; within the housing and surrounding the stem is an extensible, or compression spring 18.

Similarly between and impinging the stuffing box 10 and head of the lower stem is an extensible, or compression, spring 19 having substantially the same tension as the spring 18, and for impingement between the two heads is an extensible, or compression, spring 20 having a weight and tension greatly in excess of the springs 18 and 19.

In each stuffing box there is formed a gland 21, to receive packing around the stem, and for each gland there is a follower 22, constructed in halves, as shown, for convenience in its placement about the stem as connected in the pipe column, each half of which follower is of semicircular outline and has its interior shaped to the half section of the stem.

At the base of each follower half, or part, there is an outstanding flange 23, which completely fills the gland over the packing. The body portions of the follower are spaced from the wall of the gland to receive therebetween a gland nut 24 in the form of an open ring, externally threaded for engagement with threads 25 in the outer part of the gland and provided with means such as the slots 26 for a tool such as a spanner, for turning the nut to tight or loose fits over the packing follower.

In drilling through certain formations, there is a condition known as "balling" which fouls the tool bits and renders them inoperative and a common remedy for this condition is to "spud" the tool, which consists in raising the tool and dropping it violently upon the bottom of the hole. In other formations there is a condition known as "sticking" in which the formation by adhesion prevents or interferes with tool operation, a common remedy for which is "jerk" the tool. Obviously both of such operations impose enormous stresses in the pipe column and frequently result in breaking the pipe column especially at its threaded joints or bending the column to inoperative condition.

By reason of the parted stems forming a break in the pipe column and the springs acting on and between the parted stems, all longitudinal stresses tending to break, bend, or otherwise injure the pipe column are relieved.

The bore of the housing is divided by the head 16 of the tubular drill stem sections into upper, lower and intermediate buffer chambers 27, 28, 29, and said chambers are in communication with each other as by loose fit of the heads 16 and 17 and passages 30 in the telescopic sections 13 of the drill stem, thus allowing movement of the heads relative to each other and to the closed ends of the housing 7.

The housing with its hydrostatically filled chamber forms an anti-collapsing guiding enlargement of the drill stem adapted to be guided in a vertical course by contact with the wall of the hole, thus to facilitate or insure drilling a straight hole.

In addition to such mechanical compensation there is hydraulic cushioning provided by the housing filling with water especially in the space between the heads of the stems and the relative movement of the stems is governed by the impeded movement of the

water from such space, through the relatively smaller holes in the stems.

I claim:—

1. In a drilling apparatus, a pipe column comprising in its length a telescopic joint provided with means for compensating longitudinal stresses in the column, and means for applying hydrostatic pressure inside the joint to counter-balance the hydrostatic pressure outside the joint during drilling.

2. In a drilling apparatus, an element for coupling in the pipe column, comprising means for compensating longitudinal stresses in the column; and for equalizing inside and outside hydrostatic pressures on such column.

3. A rotary drilling column provided with axially alined relatively reciprocable tubular drill stem sections having heads, and a shell non-rotatable relative to the stem sections, and provided with a chamber inclosing the headed terminals of the stem sections; means inside the chamber for yieldingly separating the heads from each other and yieldingly separating the heads from the ends of the chamber; the bores of said drill stem sections being open to the chamber so that drilling mud may flow through and fill the column and the telescopic joint and so that the hydrostatic pressure inside and outside the joint will balance each other.

4. In a rotary drill column, a housing in combination with two drill stem sections having heads and being axially alined with each other and with the housing and telescoping with relation to the housing and provided with bores opening into the housing; and shock absorbing means to resiliently position the heads of the stems relative to each other and to the housing.

5. In a rotary well drill column, the combination with headed drill stem sections, of a housing non-rotatable relative to said sections and having closed ends through which the drill stem sections reciprocate, and the heads of which are movable inside and are open to the inter-head space in the housing; and springs inside the housing to yieldingly separate the stem heads from each other and from the heads of the housing.

6. A rotary drill column provided with headed hollow rotary stem sections and a housing in which the headed portions of said section are non-rotatably and reciprocally mounted and adapted to supply fluid mud under hydrostatic pressure to guard against collapse of the housing.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 20th day of October, 1927.

ARTHUR J. PONTI.