

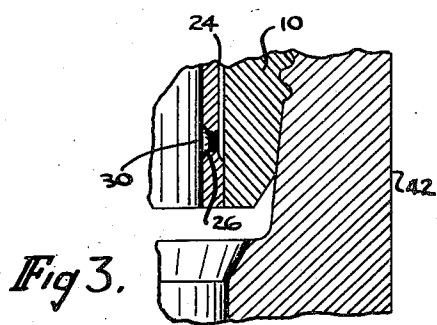
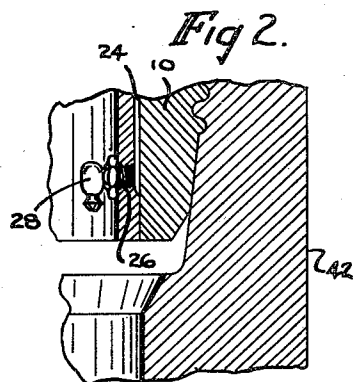
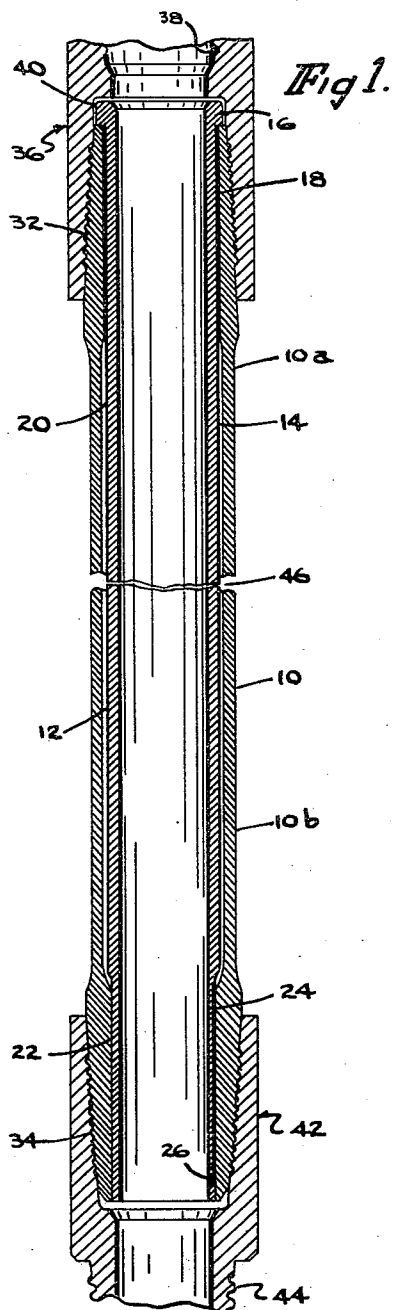
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DRILL PIPE SECTION

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1

2,808,231

DRILL PIPE SECTION

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This invention relates generally to drilling apparatus, and pertains more particularly to an improved drill pipe section.

In performing earth boring operations with heavy solid drill collars currently in use, a primary difficulty is experienced in the frequent breakage of the drill stem at or near the joints due to the extreme rigidity of the sections and the bending loads placed on the entire drill string during its rotation. Due to this drawback, drillers usually postpone the adding of drill collar sections into the drill string until a hard underground formation is actually encountered by the bit. Otherwise, there is always the likelihood of joint breakage from the time the drilling operation is started, even while drilling through the softer formations.

Furthermore, the situation is aggravated with an increase in the number of conventional drill collar sections in the drill string. Hence, drillers seldom use more than perhaps 500 feet of drill collar sections in the entire string, although the string might be several thousand feet in length. Also, it should be pointed out that in an endeavor to reduce the breakage at or near the heavy drill collar section joints, the rotation of the drill string is of necessity reduced to 40 to 60 R. P. M., even though the ideal drilling speed is of the order of 100 to 125 R. P. M. Consequently, it becomes obvious that the hole depth is advanced at a much slower rate than is desired.

Another disadvantage flowing from the use of ordinary solid wall drill collar sections resides in the fact that close watch must be practised when such solid wall drill collar sections are utilized, this action requiring that every drill collar joint be unscrewed and inspected for cracks and the like every time the bit is changed or the drill string withdrawn from the hole for some other reason.

From the foregoing explanation it will be manifest that an improved drill pipe section is needed. Accordingly the primary object of the present invention is to provide a drill pipe section capable of adding weight to the drill string without the attendant disadvantage of increasing the rigidity to the extent that solid walled drill sections have done in the past. More specifically, it is an aim of the invention to provide a drill pipe section having a composite design of such character that its double wall construction imparts the needed weight but without the unwanted rigidity that has heretofore been incorporated into solid wall drill collar sections. In this regard, it may be stated that drill pipe sections constructed in accordance with the teachings of the present invention may be incorporated into the drill string when drilling is started, and that as many of such sections may be used as are found desirable without increasing joint breakage. Also, time is saved in completing a given drilling task, for a drill string composed of drill pipe sections made in accordance with my invention may be rotated at 125 R. P. M. or faster without increased joint breakage. Additional operating data includes the increasing of the

2

drill string weight over standard drill pipe by approximately 15,000 pounds per thousand feet of drill pipe sections; drill rotating time is cut by approximately 28%, and total drilling labor time is reduced by approximately 35%. Additionally, joint inspection each time the drill string is withdrawn from the hole is eliminated or rendered unnecessary.

While the invention makes provision for minimizing the chances of joint breakage, nonetheless the invention has for a further object the facile retrieving of those drill sections below any break that might occur in the outer or torque transmitting casing there being a sleeve within the bore of each casing member capable of transmitting a lifting force in the event of breakage of any of the drill sections in the drill string.

Another object of the invention is to provide a composite or multi-element drill section having fairly close tolerances between parts so that objectionable vibration and concomitant wear is kept to a bare minimum and for all intents and purposes is wholly overcome. Thus, the invention envisages a drill pipe section that will be long-lasting in its operation.

Still further, the invention comprehends a drill pipe section that can be easily constructed with close operating tolerances that are automatically achieved during the course of assembly.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application which will be indicated in the appended claims.

In the drawing:

Figure 1 is a longitudinal sectional view of a drill section formed in accordance with the teachings of the invention, the view depicting a break in the outer casing member;

Figure 2 is a fragmentary sectional detail illustrating how a lubricant is introduced between the inner and outer members comprising the drill section pictured in Figure 1, and

Figure 3 is a view similar to Figure 2 but showing the substitution of a lubricant confining plug for the fitting shown in the corresponding figure.

To illustrate the invention, the drawing shows an outer pipe casing 10 having a bore 12 extending therethrough. Within the bore 12 is disposed a sleeve 14 equipped with an annular flange 16 at its upper end of sufficient diameter so as to overlie the upper end of the casing 10. Although not discernible in Figure 1, there is a small amount of clearance between the casing and sleeve in the region designated by the numeral 18, there being only about 0.003 inch which is small enough to dampen out any vibrational tendency before it reaches an objectionable amplitude. This clearance, however, is increased in a region below so as to provide a pronounced annular chamber 20. Adjacent the lower end of the casing 10 the bore 12 is decreased in the region denoted by the numeral 22 to such an extent that it is approximately the same as the outside diameter of the sleeve.

Prior to assembly or insertion of the sleeve 14 into the bore 12 the lower end of the casing 10 is heated in this region 22 so that a shrink fit results after the temperature of the two tubular members has had a chance to equalize once again. The contractive forces of the lower end of the casing against the sleeve, of course, effect a firm anchoring of the two members together at this lower end only. It will be appreciated that in telescoping the sleeve 14 within the casing 10, the annular flange 16 will abut the upper end of the casing and thus automatically de-

termine the relative position of the two members. Accordingly no particular care need be exercised during assembly.

Close inspection of Figure 1 will reveal that a longitudinal slot 24 is milled in the outer surface of the lower end of the sleeve 14, this slot leading from a radial aperture at 26 to the chamber 20. The purpose of the slot is to convey into the chamber 20 a fluid of higher specific gravity than the drilling mud in which the drill string is to be operated. As may be plainly understood from the detail set forth in Figure 2 a grease fitting 28 is temporarily threaded into the aperture 26 during the filling of chamber 20. After filling the fitting 28 is replaced with a plug 30, as indicated in Figure 3.

The filling of chamber 20 with fluid of the mentioned type serves several purposes. It adds weight to each drill pipe section, and this is one of the prime objects of the invention; it eliminates any tendency for the drill pipe sections to be buoyant when immersed in drilling mud; it seals each drill pipe section against the entree of water and thereby greatly reduces corrosion; and finally, it greatly reduces or eliminates possible frictional contact between the adjacent wall surfaces of the sleeve 14 and casing 10 during the drilling operation.

Both ends of the casing 10 are threaded as at 32, 34 for the accommodation of coupling members. The upper end 32 is received into the lower end of a coupling member 36, which also has a female upper end 38, only a small portion of which is visible in Figure 1. It is to be noted that the member 36 is counterbored at 40 so that when the coupling member 36 is made tight relative to the casing 10 there will still be some clearance between the coupling and the flange 16. As will be better seen later on, the coupling member 36 does not apply any pressure against the flange 16, permitting possible relative rotation. The lower end of the casing is received in the upper end of a coupling member 42, which has a male lower end 44 threaded for connection to an adjacent coupling 36 on the upper end of the next lower drill pipe section.

In making up a drill string it will be understood that a plurality of drill pipe sections assembled pictured in Figure 1 are utilized, there being a threaded connection between the coupling members 36, 42 and the casing 10 therebetween, and a further threaded connection between adjacent coupling members 36, 42 by way of the above described male and female ends. The bottom coupling member 42 of the entire string, of course, carries the bit, whereas the uppermost member 36 is connected to the power mechanism on top of the ground, all in a manner readily apparent to those skilled in this type of drilling art.

In operation, torque is transmitted from the coupling member 36 via the threads 32 to the casing 10 and thence to the lower coupling member 42 via the threads 34. The annular flange 16 rests freely on the upper end of the casing 10, rotating in unison therewith during normal operation. Because of the lack of driving connection between the casing 10 and the flange 16 it becomes quite apparent that no torque is transmitted to the sleeve 14 by way of this flange. Thus all torque imparted to the drill bit is transmitted through the various casing members 10 making up the drill string and not through any of the flanges 16.

Owing to the relative flexibility of the described composite drill pipe section the likelihood of either joint or pipe breakage is greatly minimized. However, it is always possible that a rock formation will be struck as the hole is deepened which will impose such a severe load on the string that some section thereof will break. Therefore, a break 46 has been depicted in the casing 10 appearing in Figure 1. However, it will be remembered that the flange 16 is always potentially free, being capable of transmitting no torque, so when breakage does occur only the upper half of the casing 10 (now distinguished by the reference character 10a from the lower half 10b)

continues to rotate. This causes relative rotation between the casing half 10a and the flange 16, for the lower casing half 10b now remains stationary, compelling the sleeve to remain stationary also due to the shrink fit at 22.

Knowing that a fracture has taken place the driller stops the power and raises the string for repair purposes, those sections below the break 46 being retrieved, too, by virtue of the shrink fit at 22 which prevents them from dropping.

Therefore, it will be appreciated that the sleeve 14, together with those sleeves included in the other drill pipe sections forming the complete string, adds very measurably to the overall weight of the string, thereby to permit faster drilling speeds to be employed, while at the same time affording a ready means in reserve by which the lower sections beneath the break may be retrieved along with the bit from the hole being drilled.

As many changes could be made in the above construction and many apparently widely different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

I claim:

1. A rotary drill pipe section comprising: a pair of elongated generally tubular unitary casing members arranged one within the other with their respective opposite ends proximate each other, an outer wall surface region adjacent one end of the inner casing being sealed and immovably secured within and against the proximate end of the outer casing; an integral outwardly projecting annular flange on the opposite end of the inner casing overlying and resting freely on the proximate end of the outer casing, the remaining portions of the adjacent wall surfaces of the two casings together defining a chamber surrounding the inner casing throughout the major portion of its length, said chamber having an unsealed end located adjacent the flanged end of the inner casing, and having a closed end located adjacent that region in which the proximate end of the inner casing is secured within the proximate end of the outer casing, whereby the inner casing adds weight but not rigidity to the composite walls of the complete assembly, is free from torque, tension, and bending loads applied exteriorly to the outer casing, but in case of breakage of the outer casing intermediate its ends the inner casing assumes all tension load to which the outer casing was subject prior to its breakage.

2. The rotary drill pipe section described in claim 1 in which the radial dimension of said chamber in a limited region adjacent its unsealed end is minute and of the order of a very few thousandths of an inch, whereby vibration of either casing member transmitted to the last above mentioned region is quickly damped out by the almost instantaneous actual contact of the vibrating casing with the other casing.

3. The rotary drill pipe section described in claim 1, and duct means adjacent one end thereof for introducing a fluid into said chamber.

4. The rotary drill pipe section described in claim 1, and a fluid having a greater specific gravity than oil well drilling mud substantially filling said chamber for preventing the entry of drilling mud into the chamber and for eliminating buoyancy of the assembled drill pipe section.

5. The rotary drill pipe section described in claim 1, and torque transmitting coupling means secured exteriorly to and in contact only with the outer casing.

6. A rotary drill pipe section comprising: two coaxial

5

casing members, one within the other, their respective opposite ends being proximate each other and their respective walls being spaced radially to define an annular chamber surrounding the inner casing throughout the major portion of its length; an integral flange on one end of the inner casing projecting outwardly to overlie and rest freely on the proximate end of the outer casing, a small portion of the bore of the outer casing extending longitudinally from said flange having a diameter only very slightly greater than that of the inner casing in the proximate region to provide only a very small clearance between the casings in this region, and a portion of the bore of the outer casing adjacent its other end being shrunk fitted and thus sealed onto the proximate end of the inner casing, the portion of the bore of the outer casing between the two mentioned regions near the opposite ends thereof being enlarged in diameter; and means for introducing a lubricant into said chamber.

7. A rotary drill pipe section as defined in claim 6 in which the lubricant introducing means includes a duct

6

having one end in communication with said chamber and having its other end in communication with the bore of the inner casing adjacent its shrunk fitted end; and removable means plugging the last mentioned end of said duct.

8. A rotary drill pipe section as described in claim 6, and a torque transmitting coupling member threadedly connected to that end of the outer casing proximate the flange on the inner casing, said coupling member being counterbored to avoid contact with said flange.

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