May 10, 1955 J. A. ZUBLIN 2,708,099

FLEXIBLE RESILIENT NORMALLY CURVED TUBULAR DRILL GUIDE HAVING FRICTION SHOES

Filed Dec. 7, 1951

Fig. 1.

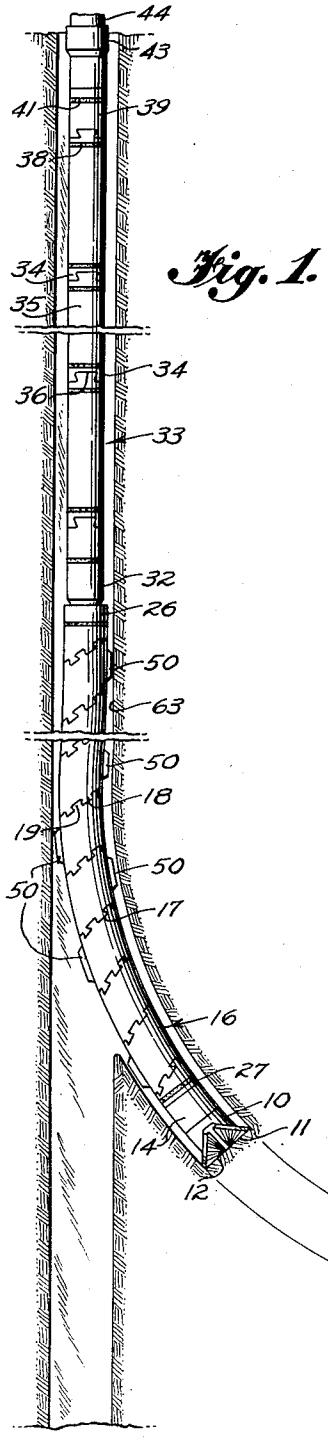


Fig. 2.

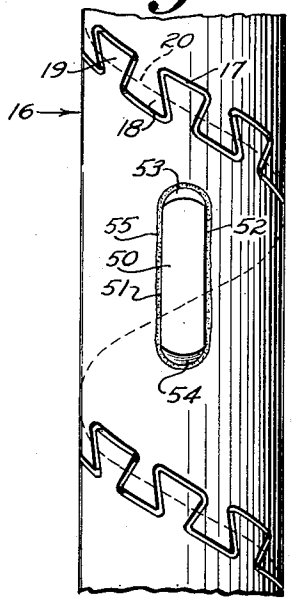


Fig. 3.

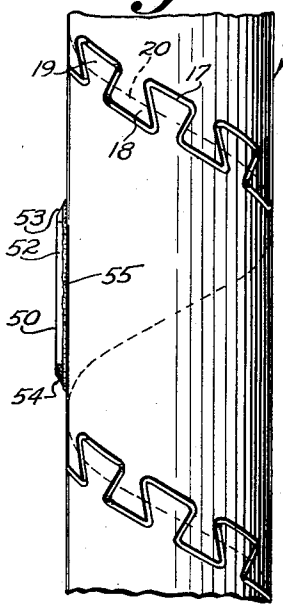


Fig. 4.

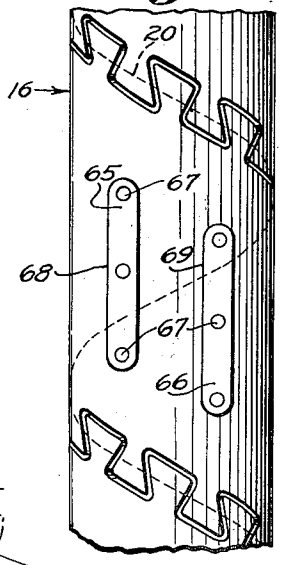
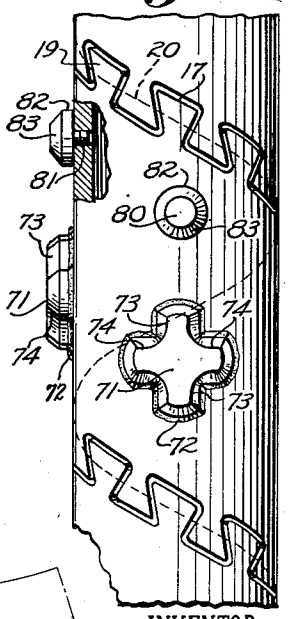


Fig. 5.



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FLEXIBLE RESILIENT NORMALLY CURVED TUBULAR DRILL GUIDE HAVING FRICTION SHOES

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Application December 7, 1951, Serial No. 260,450

2 Claims. (Cl. 255—1.6)

In my United States Letters Patent No. 2,336,338 issued on December 7, 1943, and No. 2,515,365, issued on July 18, 1950, there are illustrated and described flexible, resilient, normally curved tubular drill guides for guiding drill bits in curved paths for the purpose of drilling lateral bores deviating from existing vertical well bores. My copending applications Serial No. 64,524, filed December 10, 1948, now Patent No. 2,672,321, entitled "Apparatus for Drilling Oriented Drainholes" and Serial No. 189,591, filed October 11, 1950, now Patent No. 2,585,207 entitled "Apparatus for Drilling Lateral Bores Deviating From Vertical Well Bores" illustrate and describe more recent adaptations of flexible, resilient, normally curved drill guides for use in drilling deviating bores. These applications disclose a flexible drill pipe positioned within the resilient, tubular normally curved drill guide. The curved resilient drill guide does not rotate during drilling. The flexible drill pipe rotates within the curved drill guide to drive the drill bit. A normally disengaged clutch is provided for connecting the flexible drill pipe to the resilient, curved drill guide when it is desired to orient the curved drill guide within the well bore.

In some instances it is essential that movement of the curved drill guide relative to the well bore be prevented or restricted. Operation of the clutch mentioned above requires relative longitudinal movement between the drill pipe and the curved drill guide. This relative movement is accomplished by manipulating the drill pipe from the surface of the well while the curved drill guide remains stationary by virtue of its engagement with the walls of the well bore. Since the existing vertical well bore is usually considerably larger in diameter than the curved drill guide, there may be insufficient frictional engagement between the curved drill guide and the walls of the vertical well bore to enable the clutch to be manipulated for the purpose of properly orienting the curved drill guide for causing the apparatus to drill a lateral bore in the desired azimuth or to permit the bit to enter a previously drilled deviating bore. This difficulty is accentuated when an oil base drilling mud is used, as is common practice in the drilling of lateral bores. One of the primary objects of this invention is to overcome the foregoing difficulties by providing means which create adequate frictional resistance to movement of a curved resilient flexible drill guide relative to the walls of the well bore.

The normally curved resilient drill guide must be forcibly straightened, at least to some extent, to enable it to be lowered into the existing vertical well bore. The drill guide is held in this partially straightened condition by engagement with the walls of the well bore and there is thus considerable wear on the curved drill guide during lowering of that guide through the well bore, which may be several thousand feet in depth. I have found in some instances that the thickness of the wall of the tubular drill guide is substantially reduced by this wear, and the strength of the guide therefor weakened to an appreciable extent, after only a few trips into and out of the deep well bores. It is a further object of this invention to provide

means for protecting the normally curved drill guide from excessive wear during lowering into an existing well bore and withdrawal therefrom.

The foregoing and other objects and advantages of the invention will be better understood from the following description which has reference to the accompanying drawings, wherein:

Figure 1 is a vertical sectional view of a well bore illustrating apparatus for drilling lateral bores which apparatus embodies the present invention;

Figure 2 is an enlarged fragmentary side elevational view of a portion of the normally curved flexible resilient drill guide illustrated in Figure 1;

Figure 3 is a side elevational view taken at a ninety degree angle to the view of Figure 2;

Figure 4 is a view similar to Figure 2, but illustrating a modified form of the invention; and

Figure 5 is a view similar to Figure 2, but illustrating further modified forms of the invention.

I have illustrated a drilling bit **10** of a conventional cone type having cones **11** and **12**. The bit **10** is connected to a collar **14** which in turn is connected to the lower end of a suitable flexible drill pipe which is not shown in the drawing but which is positioned within the normally curved flexible resilient tubular drill guide **16** and which may be of the type illustrated in my above-mentioned applications Serial No. 64,524 and 189,591.

The drill guide **16** is preferably of the type illustrated and described in my United States Letters Patent No. 2,515,365, issued July 18, 1950. The drill guide consists of a tubular metal pipe having a slot through its walls extending in a generally helical path along and around the pipe. However, the slot deviates from a true helical path to provide along its sides intermeshing and interlocking teeth of dovetail configuration. The surfaces of the intermeshing and interlocking teeth are separated by the normal width of the slot while the pipe is in its normal unstressed configuration, and the pipe is flexible within the limit of deformation permitted by the width of the slot. The faces of the teeth engage when the pipe is deformed a predetermined extent in any direction and thus the teeth limit the amount of deformation. The slot is designated by the reference numeral **17** and a pair of the intermeshing and interlocking teeth are designated by the reference numerals **18** and **19**. The slot **17** extends generally along the path of the true spiral line **20**. In its normal unstressed condition the curved drill guide has a curvature which would tend to drill a lateral bore having a curvature such as that illustrated at **25** in Figure 1. It will be appreciated, however, that this ideal condition as to curvature of the lateral bore will not usually prevail in actual practice.

The normally curved drill guide **16** is provided with an anti-friction bearing **26** at its upper end and an anti-friction bearing **27** at its lower end to reduce the friction resulting from relative rotation of the bit driving flexible drill pipe and the stationary curved drill guide **16**. The lower collar **32** of a flexible drill pipe **33** is secured to the upper end of the flexible drill pipe which is within the curved drill **16**. The flexible drill pipe **33** embodies the essential features of the flexible drill pipe illustrated and described in my United States Letters Patent No. 2,515,366, issued July 18, 1950. It consists of a plurality of sections **34** of relatively thick walls of hardened steel which are joined by relatively thin walled sections **35**. The sections **34** have a slot **36** cut therein to form loosely intermeshing and interengaging teeth. The sections **34** and **35** are joined by welded seams **38**. The uppermost slotted section of the flexible drill pipe **33** is designated by the reference numeral **39**, and a threaded connector member **43** is secured thereto by means of welding material **41**. The connector member **43** is in turn connected

to the lower end of a conventional rigid drill pipe 44 which extends to the top of the well.

The normally curved resilient drill guide 16 is provided with a plurality of friction shoes 50 which are more clearly illustrated in Figures 2 and 3. The shoes 50 have angular or abrupt edges 51 and 52 which are generally parallel to the longitudinal axis of the drill guide 16. The upper and lower ends 53 and 54 of the friction shoes 50 are sloped to the surface of the drill guide. The friction shoes are illustrated as secured to the drill guide by means of welding 55 although any other suitable securing means may be employed.

It will be apparent that the angular edges 51 and 52 of the friction shoes 50 will engage or tend to engage the walls of a bore in which the drill guide is positioned, and that those edges will provide substantial resistance to rotation of the drill guide within the bore. On the other hand, the sloped ends 53 and 54 will provide only limited resistance to longitudinal movement of the drill guide within the bore. The friction shoes 50 may be secured to the drill guide in such positions and in such numbers as are found desirable. The number and the arrangement of the friction shoes illustrated in Figure 1 are such as to provide for the shoes being subjected to wear during lowering of the forcibly straightened drill guide through the vertical bore 63. The friction shoes illustrated in Figure 1 will also assist in preventing rotation of the drill guide within the vertical bore 63 or the lateral bore 25, and will also provide limited frictional resistance to longitudinal movement of the drill guide within either bore.

I have illustrated in Figure 4 a pair of friction shoes 65 and 66 which are illustrated as secured to the drill guide 16 by means of rivets 67. The friction shoes 65 and 66 have abrupt angular edges 68 and 69 which are generally parallel to the longitudinal axis of the drill guide. These angular edges provide substantial resistance to rotation of the drill guide within an earth bore. The ends of the friction shoes 65 and 66 are not tapered as illustrated in Figures 2 and 3, but provide abrupt shoulders which thus furnish greater resistance to longitudinal movement of the drill guide within an earth bore.

It is sometimes preferable to provide equal resistance to rotation and longitudinal movement of the drill guide within an earth bore. I have illustrated in Figure 5 two types of friction shoes which will accomplish this objective. Although both of these modifications have been illustrated on a single length of a flexible resilient drill guide, it will be appreciated that these friction shoe types are mutually independent and would not necessarily be used together on a resilient drill guide in the specific relation shown on Figure 5. The cross-shaped shoe 71 is illustrated as secured to the drill pipe 16 by means of welding 72. This friction shoe is provided with a plurality of angular edges 73 which are generally parallel to the longitudinal axis of the drill guide. The shoe 70 is also provided with a plurality of angular edges 74 which lie in planes which are generally perpendicular to the longitudinal axis of the drill guide. The angular edges 73 will prevent or tend to prevent rotation of the drill guide 16 within an earth bore while the angular edges 74 will provide substantial resistance to longitudinal movement of the drill guide within the bore.

I have also illustrated generally frusto-conical friction shoes 80 which are provided with threaded shanks 81 which are received in threaded openings in the wall of the drill guide 16. The shoes 80 are provided with shoulders 82 and 83 which are circular and which thus provide substantially uniform resistance to motion of the drill guide in any direction within an earth bore.

The foregoing detailed description of exemplary forms of the invention has been given to enable others to understand the invention and to obtain the benefits thereof. It is to be understood that the invention is not limited to the exemplified forms and that various modifications may be resorted to without departing from the scope of the invention as defined by the following claims.

Having thus defined my invention, I claim:

1. In an apparatus for drilling a curved bore deflecting from an existing well bore and which includes a unitary slotted pipe, said slot being of appreciable and uniform width extending at least partially around the circumference of and along said pipe whereby said pipe is resiliently flexible and may be arcuately bent, a flexible drive member rotatable within said pipe, a drilling bit connected to the lower end of said drive member to rotate therewith, means for securing said drive member to the lower end of a drill string, and clutch means including a first clutch member carried by said drive member and a second clutch member carried by said pipe, said clutch members being shiftable to cause said pipe to rotate with said drive member to permit angular orientation of said pipe, the combination therewith of radially projecting members rigidly secured on the exterior surface of said pipe in the region of said slot and spaced therefrom for frictionally engaging with the wall of the well bore, and each of said members being provided with angular edges on the engaging face thereof for direct engagement with the well of the well bore to retard rotation of the pipe.

2. An elongated flexible resilient drill guide for a flexible rotary drill string, comprising a unitary slotted pipe, said slot being of appreciable and uniform width extending at least partially around the circumference of and along said pipe whereby said pipe is resiliently flexible and may be arcuately bent, radially projecting members rigidly secured on the exterior surface of said pipe in the region of said slot and spaced therefrom for frictionally engaging the wall of the well bore, each of said members being provided with angular edges on the engaging face thereof for direct engagement with the wall of the well bore to retard rotation of the guide.

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