

Sept. 6, 1955

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2,717,146

HEAVY DUTY FLEXIBLE DRILL PIPE

Filed April 9, 1953

2 Sheets-Sheet 1

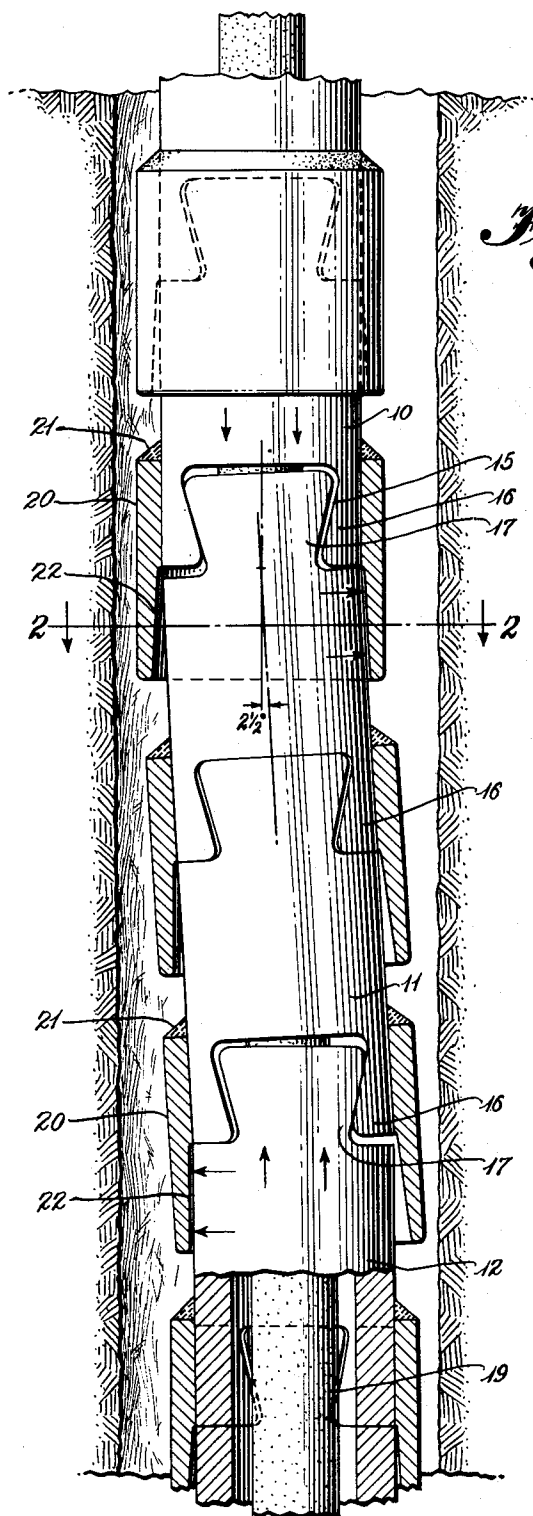
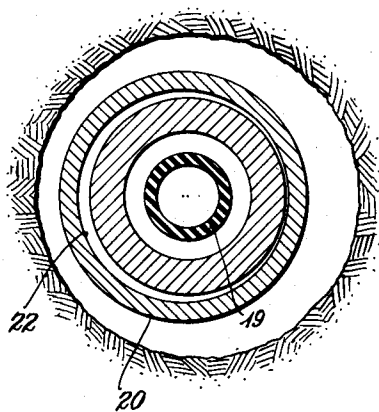


Fig. 1.

Fig. 2.



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Fig. 3.

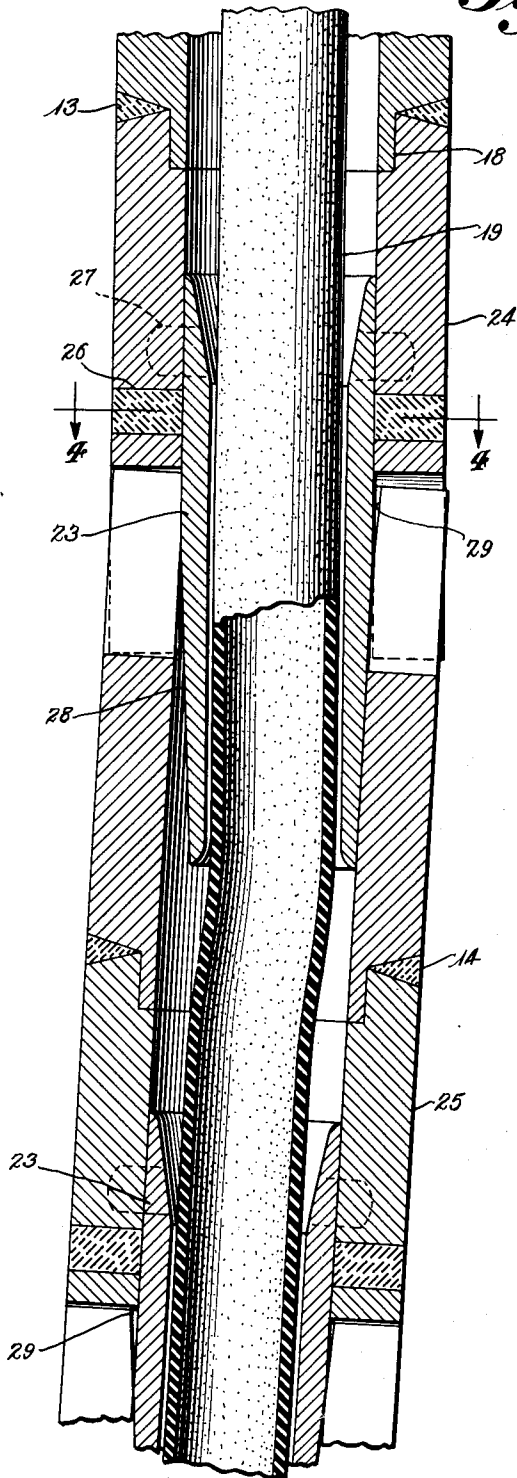


Fig. 4.

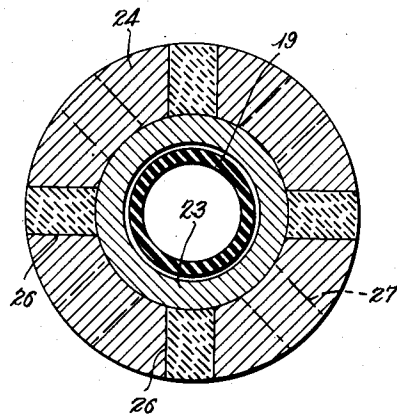
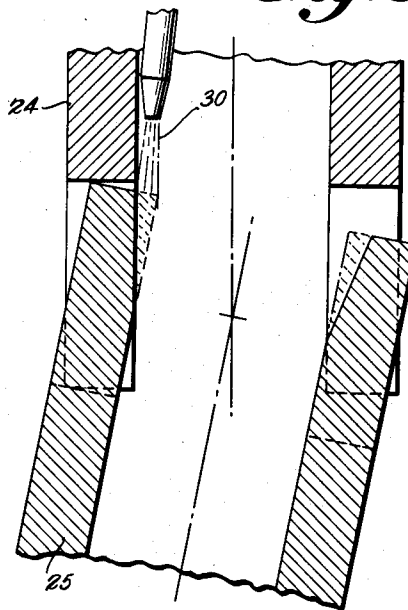


Fig. 5.



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HEAVY DUTY FLEXIBLE DRILL PIPE

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6 Claims. (Cl. 255—28)

This invention relates to heavy duty flexible drill pipe. Heavy duty flexible drill pipe is used quite extensively in the drilling of curved drain holes deviating from a vertical well bore. It is the purpose and objective of the present invention to provide a heavy duty flexible drill pipe that is especially well adapted for such use.

The present invention constitutes an improvement on the general type of heavy duty flexible drill pipe disclosed in my prior U. S. Patent 2,515,366, it being recognized that a variety of intermeshing teeth configurations may be used within the scope of the instant invention other than disclosed in such patent.

While the heavy duty flexible drill pipe of my prior patent has proved highly meritorious, instances are sometimes encountered when the intermeshing teeth of the independent sections of the drill pipe through which torsional force is applied become worn there is a tendency for the sections to buckle which permits a greater flexibility than contemplated for the particular drill pipe and furthermore increases the hazard of breaking the intermeshing teeth and possibly losing the portion of the drill string and the bit below the point of severance.

In its more specific aspects the present invention contemplates the provision of means for predetermining and limiting the extent of flexure of the heavy duty flexible drill pipe irrespective of wear on the intermeshing teeth of the individual sections.

Further and more specific advantages of this invention will become apparent as the description thereof proceeds which will be given in connection with the accompanying drawings from a part thereof and, in which:

Figure 1 is a fragmentary view in side elevation with part shown in section illustrating one embodiment of my invention.

Figure 2 is a cross-sectional view in the direction of the arrows taken on line 2—2 of Figure 1.

Figure 3 is a fragmentary cross-sectional view illustrating a modified form of my invention.

Figure 4 is a detailed cross-sectional view in the direction of the arrows taken along the line 4—4 of Figure 3 and

Figure 5 is a diagrammatic fragmentary view illustrating the method of cutting away a portion of the intermeshing teeth on one of the sections of the heavy duty flexible drill pipe.

By reference to Figure 1 it will be observed that the heavy duty flexible drill pipe of the present invention is made up of a series of independent interconnecting sections such as 10, 11 and 12. It will be understood that the uppermost of these independent sections is threaded at a free end to be received in the lower end of a conventional rotary drill string as more fully illustrated in Figure 1 of my prior Patent 2,515,366, and the lowermost section of the heavy duty flexible drill pipe will be provided with means for interconnection with like units of heavy duty flexible drill pipe or with a drill bit, as the case may be. Returning now to a description of one of the duplicate sections 10, 11, and 12, it should be observed that in both the modification

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of my invention illustrated in Figure 1 and that illustrated in Figure 3 the intermeshing teeth carrying elements of the sections are formed in the same manner. Their manner of formation can perhaps best be described by initial reference to Figure 3 wherein the annular welds 13 and 14 define the upper and lower ends of what originally constituted a tubular steel billet. This tubular steel billet is severed by an appropriate cutting torch along a line defining the configuration of the intermeshing teeth. It is the character of the torch that determines the width of the slot 15 (Fig. 1) between intermeshing teeth such as 16 and 17. After a number of tubular billets have been thus severed by a cutting torch, their previously machined ends formed to provide the overlapping joint 18 (Fig. 3) are welded together as indicated at 13 and 14. Thus, in final assembled form, any given section of the heavy duty flexible drill pipe is made up of one end of one tubular steel billet and the opposite end of another tubular steel billet.

In both modifications of my invention there extends through the heavy duty flexible drill pipe an impervious conduit 19 which may be an armored hose for the conveyance of the high pressure hydraulic circulating drilling medium as more particularly exemplified in my prior Patent 2,585,207. Referring again to the modification of Figure 1, it will be observed that each of the sections such as 10, 11, and 12, have secured to the exterior wall thereof a tubular member 20 which may be appropriately welded to its associated section such as 10, 11, and 12, through the medium of a weld such as indicated at 21. Each of the tubular members 20 projects well beyond the teeth of its associated section. The inner wall of the projecting portion of each of the tubular members 20 is cut away to provide the outward taper indicated at 22.

The arrangement is therefore such that when a given section such as 12 is moved to the left, with reference to the section 11 as shown in Figure 1, such movement will be limited by contact of that portion of the outer wall of section 12 that is telescopically received within the tubular member 20 when such portion of section 12 strikes the tapered surface 22 of the tubular member 20 carried by section 11.

It will be appreciated that there is a much larger area of contact between the tapered surface 22 of any given tubular member 20 and the outer wall of the next adjacent section than there is between the surface of the intermeshing teeth. Therefore, even though the contacting surfaces of the intermeshing teeth may wear somewhat, the tubular members 20 will effectually limit the extent of flexure of the heavy duty flexible drill pipe. Additionally in the form of the invention shown in Figure 1 the tubular members 20 act as shields that prevent contact of the teeth of the various sections of the heavy duty flexible drill pipe with the wall of the well bore safeguarding the same from abrasive wear.

Now referring to the modification of Figure 3, this modification differs primarily from the modification of Figure 1 in that the tubular members designated 23 in Figure 3 are carried on the interior wall of the associated sections designated 24 and 25 in Figure 3 rather than on the exterior thereof. The upper ends of the tubular members 23 are respectively held in the lower ends of sections such as 24 and 25 by so-called rivet welds. Radial holes indicated at 26 and 27 in Figure 4 are drilled through sections 24 and 25 and the rivet welds which interlock sections 24 and 25 respectively to their associated tubular members 23, are positioned in these openings with the respective sections 24 and 25 and the associated tubular members 23 held in predetermined telescopic relationship. In this modification the outer wall at the lower end of each of the tubular members 23

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is cut away to provide the inwardly tapered surface 28 against which the inner wall of the next adjacent section of the heavy duty flexible drill pipe is adapted to engage and to thereby limit the extent of flexure of the heavy duty flexible drill pipe. Additionally in this modification in order to facilitate the requisite freedom of movement of the intermeshing teeth of adjacent sections a portion, that is the inner corners of the teeth at the end of each section telescopically received in the tubular member 23, are cut away as indicated at 29 in Figure 3.

In this modification of Figure 3, as well as in the modification of Figure 1, there is a positive limitation on the extent of angular movement of the sections of the heavy duty flexible drill pipe which limitation of angular movement is not dependent solely upon the width of the torch cut between the intermeshing teeth.

In Figure 5 there is diagrammatically illustrated a method by which the portions of the intermeshing teeth of one of the sections may be cut away to provide the cut out portions indicated at 29 in Figure 3. Pursuant to this method the sections 24 and 25, prior to the positioning of a tubular member 23 in the section 24, are moved progressively to their maximum permitted extent of relative angular movement and the cutting torch 30 is advanced circumferentially along the inner wall of section 24. In this way the teeth of section 25 will have the requisite freedom of movement to permit the required angular displacement after the tubular member 23 has been assembled in section 24.

From the foregoing description it will be apparent the present invention provides a heavy duty flexible drill pipe possessing positive means for controlling the degree of flexure of the heavy duty flexible drill pipe irrespective of wear on the intermeshing teeth of the sections thereof and which relieves the teeth from undue strain tending to cause the same to crack or shear.

Having thus described my invention, what I claim is:

1. A heavy duty flexible drill pipe comprising an elongated tubular member subdivided into a plurality of sections of rigid pipe of substantial wall thickness in end to end relationship with a plurality of teeth and complementary recesses on the opposite ends of the intermediate sections, the teeth of one section being positioned in the recesses and loosely interlocking the teeth of the adjacent sections with appreciable clearance to form a loose joint permitting limited relative angular movement in any direction between the sections, a tubular member coaxially secured to each of said sections and projecting beyond the teeth at one end thereof, the extended portion of said tubular member overlapping and being spaced from an end portion of the next adjacent section to be contacted by and limit the relative angular movement of said next adjacent section.

2. A heavy duty flexible drill pipe comprising an elongated tubular member subdivided into a plurality of sections of rigid pipe of substantial wall thickness in end to end relationship with a plurality of teeth and complementary recesses on the opposite ends of the intermediate sections, the teeth of one section being positioned in the recesses and loosely interlocking the teeth of the adjacent sections with appreciable clearance to form a loose joint permitting limited relative angular movement in any direction between the sections, a tubular member coaxially secured to the exterior wall of each of said sections and projecting beyond the teeth at one end thereof, the extended portion of said tubular member overlapping and being spaced from an end portion of the next adjacent section to be contacted by and limit the relative angular movement of said next adjacent section.

3. A heavy duty flexible drill pipe comprising an elongated tubular member subdivided into a plurality of sections of rigid pipe of substantial wall thickness in end to end relationship with a plurality of teeth and complementary recesses on the opposite ends of the intermediate sec-

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tions, the teeth of one section being positioned in the recesses and loosely interlocking the teeth of the adjacent sections with appreciable clearance to form a loose joint permitting limited relative angular movement in any direction between the sections, a tubular member coaxially secured to the interior wall of each of said sections and projecting beyond the teeth at one end thereof, the extended portion of said tubular member overlapping and being spaced from an end portion of the next adjacent section to be contacted by and limit the relative angular movement of said next adjacent section.

4. A heavy duty flexible drill pipe comprising an elongated tubular member subdivided into a plurality of sections of rigid pipe of substantial wall thickness in end to end relationship with a plurality of teeth and complementary recesses on the opposite ends of the intermediate sections, the teeth of one section being positioned in the recesses and loosely interlocking the teeth of the adjacent sections with appreciable clearance to form a loose joint permitting limited relative angular movement in any direction between the sections, a tubular member coaxially secured to the exterior wall of each of said sections and projecting beyond the teeth at one end thereof, the inner wall of the extended portion of said tubular member being tapered outwardly toward its free end with said tapered surface overlapping and being spaced from an end portion of the next adjacent section to be contacted by and limit the relative angular movement of said next adjacent section.

5. A heavy duty flexible drill pipe comprising an elongated tubular member subdivided into a plurality of sections of rigid pipe of substantial wall thickness in end to end relationship with a plurality of teeth and complementary recesses on the opposite ends of the intermediate sections, the teeth of one section being positioned in the recesses and loosely interlocking the teeth of the adjacent sections with appreciable clearance to form a loose joint permitting limited relative angular movement in any direction between the sections, a tubular member coaxially secured to the interior wall of each of said sections and projecting beyond the teeth at one end thereof, the outer wall of a substantial portion of the extended portion of said tubular member being tapered inwardly to provide a tapered surface overlapping and being spaced from an end portion of the next adjacent section to be contacted by and limit the relative angular movement of said next adjacent section.

6. A heavy duty flexible drill pipe comprising an elongated tubular member subdivided into a plurality of sections of rigid pipe of substantial wall thickness in end to end relationship with a plurality of teeth and complementary recesses on the opposite ends of the intermediate sections, the teeth of one section being positioned in the recesses and loosely interlocking the teeth of the adjacent sections with appreciable clearance to form a loose joint permitting limited relative angular movement in any direction between the sections, a tubular member coaxially secured to the interior wall of each of said sections and projecting beyond the teeth at one end thereof, the teeth of said sections at the ends thereof opposite said projecting tubular member having their inner surfaces tapered to facilitate angular movement of said sections, the outer wall of a substantial portion of the extended portion of said tubular member being tapered inwardly to provide a tapered surface overlapping and being spaced from an end portion of the next adjacent section to be contacted by and limit the relative angular movement of said next adjacent section.

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