This invention relates to a method of removing stuck pipe from wells.

At times pipe or screen becomes tightly stuck in well bores and is very difficult to remove when it becomes desirable to remove the same. In some cases the stuck pipe may be removed by means of a grappling tool but in many cases the pipe, or screen, must be cut, or unscrewed, and removed a section at a time. In some cases, however, the stuck pipe cannot be pulled as a unit; neither can it be unscrewed and removed and in many cases it is so tightly stuck that it is not practical to cut the same into sections and pull the cut off sections one at a time.

The present method involves cutting the stuck pipe or screen into sections, then milling away and simultaneously vibrating the cut off section until it becomes loose in the bore and can be easily withdrawn. In removing screen by the method herein disclosed a washing fluid may be forced down into the bore and out through the screen whereby it may be washed loose or whereby the washing process in combination with the milling process will release the cut off section so that it may be pulled out.

With the above and other objects in view the invention has particular relation to a novel process, an example of which is given in this specification and illustrated by the accompanying drawings, wherein:

Figure 1 shows a side elevation of a combined reaming and pulling tool illustrating the operation of milling a cut off section of pipe.

Figure 2 shows a side elevation of said tool shown in engagement and removing the section to be pulled.

Figure 3 shows a cross-sectional view taken on the line 2—2 of Figure 1.

Figure 4 shows a side elevation of a combined milling tool and pulling illustrating the operation of reaming, or milling, out a well screen.

Figure 5 shows a side elevation of said tool in engagement with the screen preparatory to pulling the same, and

Figure 6 shows a cross-sectional view taken on the line 6—6 of Figure 4.

Referring now more particularly to the drawings, the numeral 1 designates the body of the milling tool which is connected to the lower end of a tubular operating string 2 extending to the ground surface. Extending outwardly from the body 1 are the milling cutters 3 whose lower margins are formed into cutting edges extending out a sufficient distance to engage and cut away the upper end of the section 4 of the stuck pipe. The lower end of the body 1 is reduced in diameter and extended downwardly forming a mandrel 5 whose lower end is flared forming the expander 6 having a longitudinal, external key 7 thereon. The expander terminates, at its lower end at the external, annular upwardly facing shoulder of the guide 9 formed on the lower end of the mandrel. Around the mandrel there is an expansible jaw 10 open at one side and having the external, upwardly pitched teeth 11. Rotatable about the upper end of the mandrel there is an antifriction ring 12 and interposed between this ring and the lower end of the ring are the antifriction ball bearings 13.

During the milling, or cutting, operation the expansible jaw 10 will be held in yielding contact with the inside of the pipe, or screen, as shown in Figure 4 with its upper end resting against the ring 12 as the tool moves downwardly during the cutting, or milling, operation the jaw 10 will be forced downwardly along the pipe, or screen, readily yielding for that purpose. While in this position the key 7 will be beneath the body 10 as shown in Figures 1 and 4 so as not to interfere with the rotation of the mandrel.

In carrying out the process, or method, herein disclosed the stuck pipe, or screen, is first cut at the point 14 by a suitable milling tool provided for the purpose. If the pipe to be removed is a solid pipe and is not a screen a tool such as shown in Figures 1 and 2 is lowered into the cut off section until the cutters 3 land on the upper end of the cut off section with the keys 7 beneath the jaw 10 and the tool is then rotated milling away the upper end of the cut off section as shown in Figure 2. During the cutting operations the cut off section 4 will be vibrated and, of course, as it is cut away and becomes shorter it will have less frictional contact with the surrounding formation and eventually the cut off section will become loose and will begin to turn. Thereupon, the operating string may be pulled upwardly and, if necessary, turned to align the keys 7 with the open side of the jaw 10 permitting the expander 6 to move upwardly and expand the jaw into engagement with the cut off section which may then be readily withdrawn to the ground surface.

The process is much the same in recovering screen excepting that the reamers 3c, as shown in Figures 4 and 5, do not extend far enough to completely cut away the screen section 4c. Usually well screen is wrapped with screening wire and if it be attempted to cut away the
complete screen this wire will become loose and will become entangled with the cutting tool thus interfering with and completely stopping the progress of said tool. Therefore, it has been found to be most practical to merely ream out 6 the perforated supporting pipe of the screen as shown in Figures 4 and 5 leaving the pipe very thin but still sufficient to support the screen wire. Before lowering the reaming and pulling tool into the well a section of the screen is first cut off as at 14, Figure 4, and the tool is then lowered into the cut off section 4a and lowered to ream out said section. Meanwhile washing fluid may be forced down through the screen and cut into the formation to assist in washing the cut off section loose. As the reaming operation progresses the walls of the screen above, being thin, will be readily flexible and will therefore yield and become loose and as the reaming operation continues the cut off section will eventually be freed from the walls of the formation and will begin to turn with the tool and thereupon the tool may be pulled upwardly causing the expander 6 to expand the jaw 10 into engagement with the screen section 4a which may be then readily pulled out of the well.

What we claim is:

1. The method of removing a stuck tubular member from a well bore which consists in first severing a section of the pipe, removing a portion of the severed section by applying a rotatable cutting tool thereto and continuing the operation until the severed section becomes loose in the bore, then removing the severed section by pulling the same from the well.

2. The method of removing stuck pipe from a well bore which consists in successively severing the pipe into sections, successively applying a rotatable cutting tool to the sections as severed and continuing the operation on each section until the same is partly cut away and the remaining portion released to move, then pulling the released section from the bore.

3. The method of removing stuck tubular members from a well bore which consists in cutting the stuck pipe to sever an upper section of pipe from the whole length of stuck pipe, applying a rotating cutting tool to the upper end of the severed section until the severed section is reduced in length sufficiently to be released to move, and then pulling the released section from the bore.

4. The method of removing stuck pipe from a well bore which consists in successively applying a rotating cutting tool to the upper ends of severed sections until the section being cut is reduced in length sufficiently to be released to move, and pulling each section from the well bore as it is released.

5. The method of removing a string of stuck pipe from a well bore which method consists in progressively severing sections from the upper end of the string, applying a rotatable cutting tool to each section, when severed and continuing the cutting operation to remove a portion of the section and to loosen said section, then removing the loose section from the well.

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