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MEANS AND METHOD OF REMOVING PIPE FROM WELLS

Filed March 21, 1931

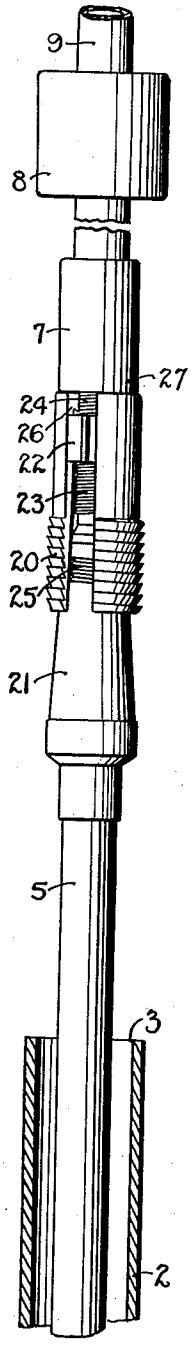


Fig. 1.

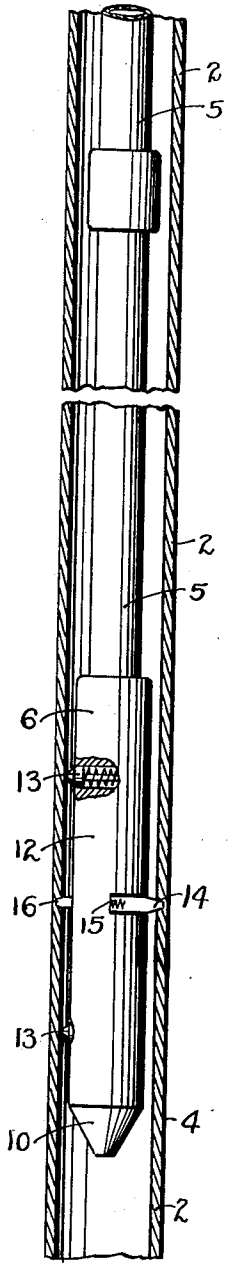


Fig. 2.

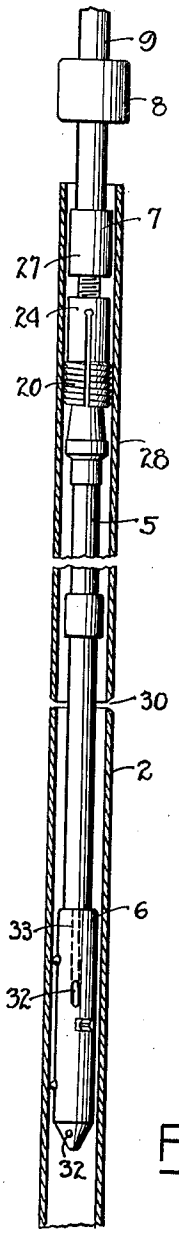


Fig. 3.

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UNITED STATES PATENT OFFICE

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MEANS AND METHOD OF REMOVING PIPE FROM WELLS

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The invention relates to an improvement mechanism and in the method of operation removing pipe from wells.

In drilling and operating wells produc- g oil, gas or water, it is necessary that one more strings of pipe be placed in the well. many instances a casing is placed in the ıll to support the walls of the formation. side of this casing may be one or more ings of pipe or tubing in order to drill flow the well. It often occurs that one or ɔre of these strings of pipe must be re- ɔved from the well either to replace the mp or chokes to fit new screen at the bot- m of the well, to salvage the pipe if the ıll is to be abandoned, or in order that the ıll may be drilled out to reach a deeper oducing formation.

There are many circumstances which cause e or more of these strings of pipe to be- me anchored in the well and when it is cessary to remove them removal of the ing as a whole is impossible. It then be- mes necessary to cut off a portion of the ing of pipe which is to be removed and move the cut off portion. This operation repeated, cutting the string of pipe into many pieces as necessary in order to ac- mplish its removal. Sometimes it is im- ssible to remove the pipe due to the cav- g of the well bore so that sand or other ıterial becomes lodged about the pipe. metimes the string of pipe will break in o and fall to the bottom of the well so that nds and kinks occur in the pipe and it is possible to remove it due to this bent con- ɔion. In some instances pieces of consid- ıble length may be cut off and removed ıereas under other circumstances it may possible to remove a piece of but a few feet length after each cut.

When a piece of pipe is to be pulled or cut ɔm the well it is generally of advantage to ıintain a circulation of water or flushing id in and around the piece of pipe in order assist in its removal. In some instances, ɔo, there may be present a considerable gas oil pressure in the well and in order to pre- nt a blow-out of the well it is necessary to ıintain a circulation of heavy mud in the well while the pipe is being cut and pulled. In order to do this both the cutting and the pulling tool must be so constructed that a circulation of this fluid may be maintained not only while the cut is being made, but also during the pulling operation.

Various types of cutting tools have been devised heretofore and also various types of pulling tools have been devised. The present invention, however, relates to the combination of a pulling tool and a cutting tool which are to be carried by a single string of pipe, and both tools are to be operated by this same string of pipe.

In order to provide a pulling tool which will be capable of withstanding the necessary force to pull the pipe the pulling tool must be of such size that it will fit snugly into the pipe which is to be pulled when such pulling tool is in contracted position. When this pulling tool, however, is to fit closely within the pipe to be cut it has been found that it is impossible to rotate the same without engagement with the piece of pipe that is being cut off. Inasmuch as it is necessary to rotate the cutting tool to accomplish the cut, the present invention has been devised wherein the pulling tool is so spaced above the cutting tool that it is beyond the upper end of the piece of pipe which is being cut during the cutting operation, and after the cut has been completed the pulling tool is then lowered into position to accomplish the removal of the cut off piece of pipe.

It is one of the objects of the invention to provide a cutting tool and a pulling tool in combination with a single string of pipe for removing cut off pieces of pipe from a well.

Another object of the invention is to provide in combination with an operative string of pipe a cutting tool and a pulling tool so disposed that the pulling tool will be inoperative during the cutting operation.

Another object of the invention is to provide a combination cutting and pulling tool assembly wherein circulation of fluid through the pipe being cut may be maintained during both the cutting and the pulling operations.

A still further object of the invention is to accomplish the removal of the pipe from

wells by the method of cutting off a piece of pipe and then lowering a pulling tool into the cut off piece of pipe to remove the same.

A still further object of the invention is to provide in combination with a string of pipe, a cutting tool and a pulling tool, as well as a stop collar to indicate when the pulling tool has been lowered into the cut off piece of pipe.

A still further object of the invention is to provide an inside cutting tool wherein circulation may be maintained at all times.

A still further object of the invention is to provide a method of making a plurality of cuts in a pipe in a well bore and removing the cut off pieces of pipe without removing the cutting tool from the well.

Other and further objects of the invention will be readily apparent to those skilled in the art, wherein the following description is considered in connection with the accompanying drawings, wherein:

Figs. 1 and 2 show an assembly of an apparatus for practicing the invention, wherein Fig. 2 is a continuation of the assembly which is seen in Fig. 1 with the parts in their respective positions during the cutting operation.

Fig. 3 is a more or less diagrammatic view showing the positioning of the parts after the cutting has been completed and the pulling tool lowered into the cut off piece of pipe preparatory to pulling the same from the well.

The invention may best be understood by having reference to Figs. 1 and 2 wherein a pipe 2 is shown, which pipe may be disposed in a well. This pipe may be a section of casing which is lodged in the well with the formation abutting against the outer surface, or it may be a section of tubing which is disposed in the well bore, or inside of a casing in the well. This pipe 2 illustrates a portion of the pipe which is to be removed from the well by practicing the present invention. This piece of pipe 2 may be of any length, and in some instances may extend several thousand feet into the well. The position at which it is firmly held in the well is usually unknown and in attempting its removal it is desirable to remove as great a piece at each cut as possible. The upper end of this pipe is indicated at 3 and it is intended with the illustrations of Figs. 1 and 2 that the distance between the point 4 which is adjacent the cutting tool, and the point 3 which is the top of the pipe, may be several hundred or as much as a thousand feet. It will, therefore, be apparent that the drill stem or string of pipe 5 which serves to support the cutting tool 6 will be of considerable length. It is intended, however, that the length of this string of pipe which spaces the cutter 6 and the pulling tool 7 shall be of any length desired.

It is intended, however, that this length may be varied in accordance with existing conditions encountered at each particular well where it is desired to remove the pipe. Knowledge of the conditions as to how the pipe to be removed became anchored or lodged in the well is, of course, a material factor as this enable the operators who are to remove the pipe assembly to place their fishing tools according to these conditions.

In practicing the present invention it is intended that the string of pipe will be made up with tool joints or couplings connecting the various sections together, and with the cutting tool 6 adjacent the lowermost end. Spaced above the cutting tool 6 will be the pulling tool 7. The particular space between the two tools will be determined at the time they are being lowered into the well, because, if the operator knows that there is several hundred feet of pipe which can be removed by performing a single cut it would then, of course, be advisable to place a length of pipe 5 between the two tools at least equal to the length of pipe which was known to be free, or which it was believed can be removed by a single pull with the tool 7. With this in mind additional sections are coupled on above the cutting tool 6 until it is believed that the cutting tool is sufficiently spaced into the well. The pulling tool 7 is then connected into the line.

Above the pulling tool 7 is a stop collar 8 connected into the line. This stop collar serves a specific purpose which will be later described. Above the stop collar 8 additional sections of pipe 9 are connected and as these connections are made the cutting tool 6 and the pulling tool 7 are gradually lowered into the well bore. The lower end of the cutting tool 6 is preferably tapered as at 10 so that it will find its way into the end 3 of the pipe 2. Additional sections of pipe 9 are added at the surface until such time as the cutting and pulling tools have moved down into the well so that the stop collar 8 abuts against the end 3. When this occurs the operator is advised that his pulling tool has passed into the pipe which is to be pulled. The construction of this pulling tool 7, however, is such that it is made up with as sturdy a construction as possible, and accordingly is made up of a maximum diameter which will fit snugly inside the pipe 2. Due to the fact that this pulling tool 7 is arranged to fit snugly within the pipe it is inadvisable to attempt to rotate the mechanism with this pulling tool inside the pipe 2, and with this in mind the operator will then withdraw from the well a sufficient length of the pipe 9 so that the pulling tool 7 will be moved to an elevation slightly above the upper end 3 of the pipe 2. In other words the parts will be moved to the position shown in Figs. 1 and 2, with the pulling tool directly above the pipe 2 which is to be cut. With the

parts in this position the cutting tool 6 will be spaced downwardly from the end 3 of the pipe to be cut, a distance substantially equal to the length of the pipe 5 which has been coupled between the cutting tool and the pulling tool.

The cutting tool which is illustrated in connection with the present invention is of a particular type disclosed in Patent No. 180,424, granted, April 21, 1931, to Ellsworth Gray. It is intended, however, that different types of cutting tools may be used so long as they are capable of accomplishing the cutting operation as is required in connection with this invention.

The tool 6 here illustrated is of a type which embodies a housing 12 which carries a pair of spring pressed, non-cutting plungers 13. These plungers are diametricaly disposed in the housing 12 with respect to the cutter blade 14. This cutter blade 14 is pivoted in the housing to swing transversely, and the pivot on which it is mounted is eccentric of the housing 12. A spring 15 is provided which prevents the cutting blade 14 from collapsing to a position entirely within the housing. The cutting blade 14 is of such construction that rotation of the housing 12, preferably in a right hand direction, causes the heel of the cutter blade to engage with the pipe 2 and due to its eccentric mounting the blade 14 will then be moved to an extended or operative position. This extended movement of the cutter blade causes the housing 12 of the cutter to move away from the point of contact with the blade against the casing 2, and in this manner causes compression of the springs bearing against the plungers 13. The tool is now rotated and the springs behind the plungers 13 constantly press the cutter blade against the pipe 2 so that continued rotation forms the cut 16 as best seen in Fig. 2.

The transverse sliding movement of the plungers 13 is so governed that when they are moved to extended position the toe of the cutter blade 14 will have severed the pipe 2. With a cutter of this type no anchor for the cutter as to elevation is necessary as the cutter is not operated by fluid pressure or by vertical movement of the cutting tool, but performs the cutting by the mere rotation of the tool.

While the cutting tool 6 has been rotated by rotation of the string of pipe 5 and 9 as has been previously described, the pulling tool 7 is above the upper end 3 of the pipe being cut. When the cut is complete the operator who is at the surface is apprized of this fact as it is usual for the rotary to speed up, due to the decreasing resistance to rotation when the blade 14 has completely severed the pipe. When the operator thus realizes that the cut is completed he will discontinue rotation and back up the tool about one quarter of a turn or revolution. This is for the purpose of moving the cutter blade 14 to retracted position and the pressure of the plungers 13 thus moves the cutting tool diametrically away from the point of contact with the casing of the plungers. The entire assembly is now lowered slightly so that the pulling tool 7 will move into the upper end 3 of the pipe 2 and the parts will then be substantially in the position shown in Fig. 3. The cutter 6 having been moved downwardly a distance equal to the distance which the pulling tool extended above the top of the pipe which has been cut off. The operator may lower the string of pipe until the stop collar 8 abuts against the upper end 3 and he is then assured that his pulling tool has entered the piece of pipe. However, Fig. 3 merely shows the mechanism as having been lowered to such an extent that the pulling tool has entered the pipe 2.

The pulling tool 7 is operated by the movement of the mandrel 21 with respect to the jaws or slips 20 so that the jaws are expanded to engage the inside of the pipe or tubing 2. This movement is accomplished by rotation of the string of pipe 9, of which the stem 23 is a part. This stem 23 is threaded at 24 so that the nut 22 will travel thereon when the jaws 20 engage the pipe 2. The stem 23 is threaded at 25 in a direction opposite to the pitch of the threads 24 and the mandrel 21 is supported on this stem 23 by means of the threads 25. The jaws 20 are supported above the nut 22 by the ring or collar 26. Thus when the jaws are moved inside of the pipe 3 and the stem 9 is rotated the nut 22 will be moved downwardly and the mandrel 21 will preferably be moved upwardly. Under these conditions the jaws 20 will expand and grip the pipe so that the collar 24 will assume the position shown in Fig. 3 spaced away from the head 27 of the pulling tool. With the parts in this position, as seen in Fig. 3, a pull is exerted on the stem 9 in an attempt to dislodge the piece of pipe 28, which has been severed from the pipe 2 at the point 30 by means of the cut 16.

If the piece of pipe 28 can be dislodged by pulling on the tool it is then raised to the surface by disconnecting pieces of the drill stem 9 until the upper end 3 of the pipe reaches the surface. The piece of cut off pipe is then removed either by disconnecting the sections thereof, or if it is of a length which may be disconnected inside of the derrick, it is removed. The pulling tool is then connected again to the pipe 5 and the combination cutter and pulling tool is again lowered into the well.

In event, however, that the piece of pipe 28 can not be dislodged but is held firmly by the formation, or for some reason can not be pulled from the well, it is usually desirable to circulate a flow of water or flushing fluid down through the pipe 2. This flow

of fluid may pass through the bottom of the pipe 2 and upwardly around the outside thereof in order to dislodge the débris or other material which is holding the piece of pipe 28. If the lower end of the pipe 2 is blocked the flow of fluid will pass out of the cut 30 and around the piece of pipe 28 so that the pipe may be dislodged. In order to permit this flow of flushing fluid the cutter 6 is provided with a plurality of openings 32 which are connected with the interior of the string of pipe 5, as indicated by the passage shown in dotted lines at 33. This flow of flushing fluid or water must also pass through the pulling tool 7 and the stem 23 thereof is hollow to permit such flow of fluid. The fact that this stem 23 must be hollow is the reason why it is necessary to construct the pulling tool 7 of as great a diameter and of as sturdy construction as possible, and it is for this reason that the pulling tool is rotated above the end of the pipe 3 during the rotation of the cutter because it fits so snugly within the pipe that rotation, while the pulling tool is in the pipe 3, would be impossible.

In event, however, that the piece of pipe 28 can not be pulled either with a direct pull or after a circulation has been maintained, or it has been found impossible to establish circulation, the pulling tool 7 will be released from its grip on the upper end 3 of the pipe. This releasing is accomplished by rotating the string of pipe 9 in a reverse direction from that which was necessary in order to set the pulling tool. This rotation in a reverse direction causes the mandrel 21 to travel downwardly on the threads 25 and the nut 22 to travel upwardly on the threads 24. In this manner the nut 22 engages the collar 24 and withdraws the jaws 20 from the tapered surface of the mandrel 21. In this manner they will contract normally and release the grip upon the pipe 3. The entire mechanism is then raised to such a position as the driller may have reason to believe that he can perform another cutting operation and successfully remove the piece of cut off pipe. In other words, the cutter 6 will be moved to a position above the cut 30. Obviously the pulling tool 7 will, during this second cutting operation, be at a position above the top of the pipe 3, a distance at least equal to the distance between the first cut 16 and this second cut which is to be made. This distance, however, has no effect whatever upon the operation of the tool and a second cut is thus performed. When this second cut has been completed the tool 6 is backed off as previously described and the entire mechanism is lowered so that the pulling tool 7 will again grip the upper end 3 of the pipe and an effort wil be made to pull off the upper end of the piece of pipe 28, which has been severed by this second cut.

If the operator is successful in pulling this shorter piece of cut-off pipe, it is then removed and the mechanism is lowered into the well and an attempt is made to pull the remainder of the piece of pipe 28, which was not removed by the preceding operation. In event, however, the operator is unable to pull the last and shorter piece of pipe which has been severed by the second cut he again tries to circulate and if unsuccessful or unable to pull this piece of pipe, the operations may be again repeated as many times as necessary until he has cut off such a short piece of pipe that he is enabled to pull it from the well. In actual operation it has been found that in some instances a considerable number of cuts may be made and it has been found impossible to pull any except a very short piece of pipe from the top. However, as soon as one piece of pipe is pulled the operator knows that he has in the well a number of pieces of pipe equal to the number of cuts which he has already made, and he is enabled to pull them from the well at will, or to perform other cuts in order to remove the pieces of pipe. It seems apparent that with this mechanism it is possible to make an attempt at least to pull a very long piece of pipe and if unsuccessful a shorter piece of pipe may be severed and removed by merely manipulating the mechanism but without removing it from the well. This is of material advantage over the devices now in use wherein the cutting tool is lowered into the well on a string of pipe and the cut performed. The tool is then removed and is replaced on the lower end of the string of pipe by a pulling tool or spear and this pulling tool is lowered into the well and an attempt made to remove the piece of pipe which has been cut off. If, however, this attempt is unsuccessful it is necessary for the operator to completely remove his pulling tool from the well and re-insert the cutting tool.

In event the cut is being made at any considerable depth in the well, a great deal of time and expense is necessary in interchanging the cutting tool and the pulling tool, whereas with the assembly in accordance with the present invention, cuts and pulls may be made alternately without removing the mechanism from the well so that a great saving of time is effected and a material economy and advantage obtained.

It is to be understood that the stop collar 8 may or may not be provided in connection with the assembly but it is desirable because it assures the operator of an indication as to when the pulling tool has entered the upper end of the cut-off piece of pipe.

The present method of removing pipe from wells is believed to be of material advantage over the methods now in general use because it simplifies the procedure, assures the operator of removing at least a small piece of pipe on each trip out of the well and eliminates

double trip into and out of the well, which necessary when using the cutting tool and e pulling tool independently of each other. nother material advantage is the fact that rculation may be maintained through both ıe cutting tool and the pulling tool while ıey are either operative or inoperative and event the pipe is being removed from a ell in which there is a considerable gas or ;her pressure and it is necessary to fill the ell bore with mud to overcome this pressure ı order to remove the pipe, circulation of ıis mud may be maintained at all times dur- ıg the operation of the cutting and the pull- ıg tools, due to the fact that the stem 23 is ollow and the passage 33 and discharge 32 re formed in the cutting tool.

Having described the invention what I laim is:

1. A combination cutting and pulling tool dapted for removing pipe from wells in- luding an operating string of pipe, a cut- ing tool at the lower end thereof, a pulling ool, means comprising a part of said oper- ting string for interchangeably spacing said ulling tool in said string above said cutting ool at different distances so that it may be bove the top of the pipe being cut during he cutting operation such puller being dapted to be lowered into the cut off pipe o remove the same, and a stop collar on said tring of pipe to limit the movement of said ulling tool into the cut off pipe.

2. The combination of a cutting tool and pulling tool for removing pipe from wells, single string of pipe to operate both of said ools, and means including a portion of said tring of pipe for variably spacing said pull- ng tool from said cutting tool in said string f pipe so that it may be above the pipe being ut off during the cutting operation.

3. A method of removing pipe from wells ncluding the steps of lowering into the well ı string of pipe with a cutting tool and a ulling tool, positioning the string of pipe with respect to the pipe to be cut so that the ulling tool is above the end of the pipe, ro- ating the string of pipe to perform the cut- ing, lowering the pulling tool into the cut off piece of pipe, and pulling this cut off piece of pipe from the well.

4. A method of removing pipe from wells including the steps of lowering a cutting tool and a pulling tool into the well bore in spaced relation to each other at least a distance equal to the length of the piece of pipe to be cut, cutting off the piece of pipe, and lowering the pulling tool into the cut off piece of pipe and removing the same.

In testimony whereof I hereunto affix my signature this 16th day of March, A. D. 1931.

ROBERT A. MUELLER.