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2,353,284

MILLING TOOL

Filed Sept. 27, 1943

2 Sheets-Sheet 1

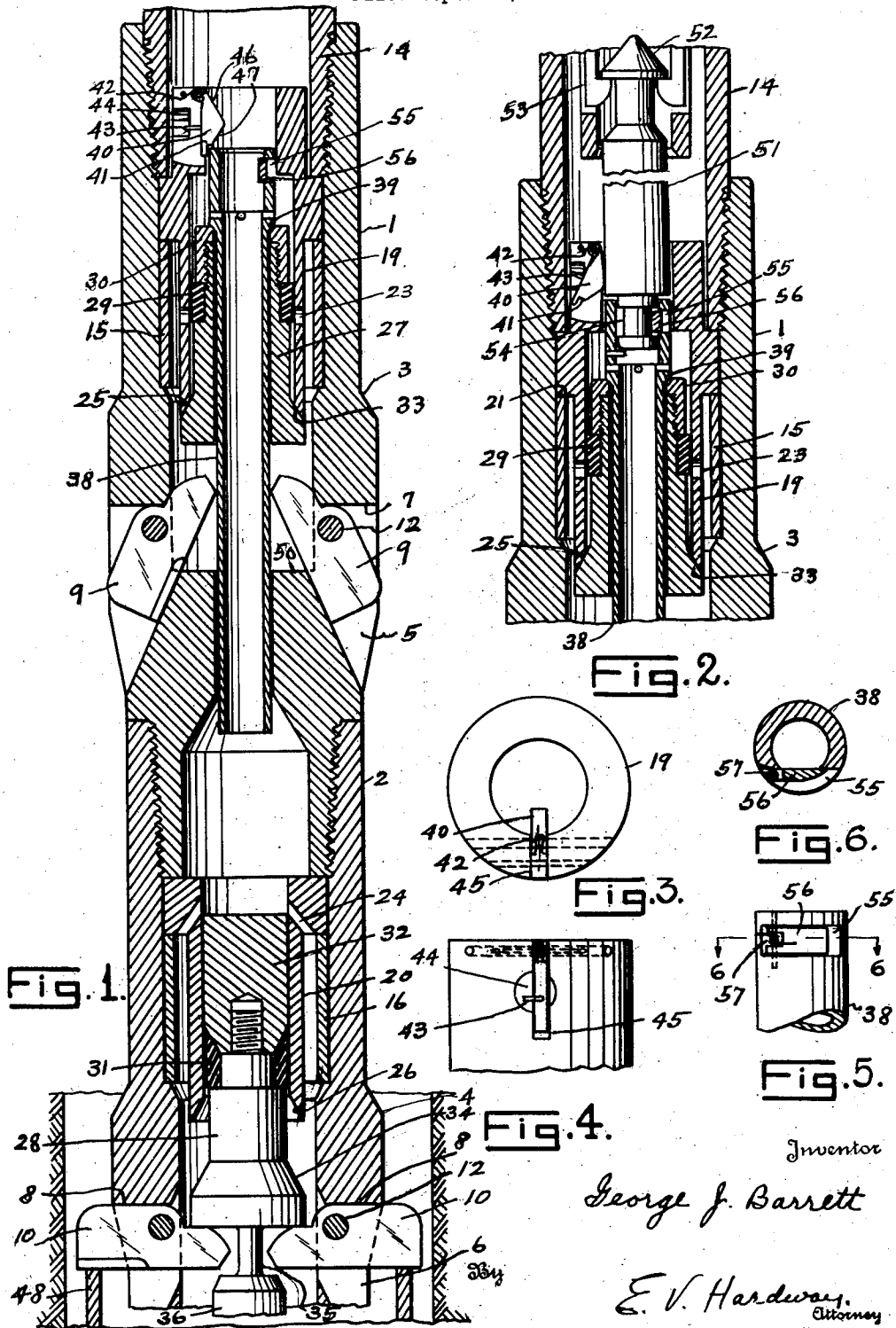


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 6.

Fig. 5.

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2 Sheets-Sheet 2.

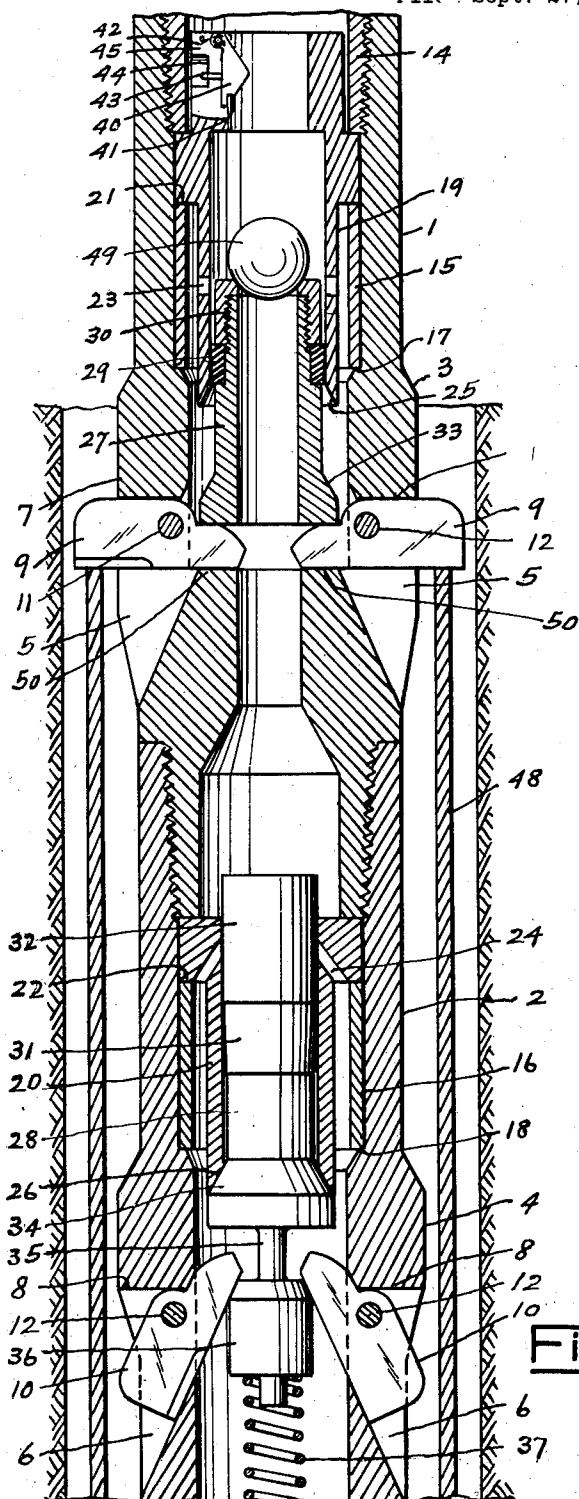
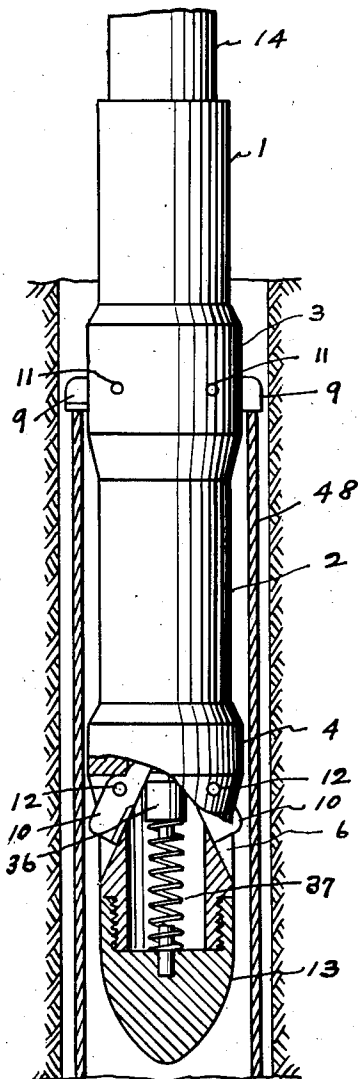


Fig. 8.

Fig. 7

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MILLING TOOL

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10 Claims. (Cl. 164—0.8)

This invention relates to a milling machine.

An object of the invention is to provide a pipe milling, or pipe cutting machine, specially adapted for use in a well bore for milling out and removing pipe in the bore.

At times, it becomes desirable to remove a section, or sections, of pipe in a well bore so as to expose the formation opposite the removed section. This may be desirable for side tracking operations in well drilling or to expose a producing stratum in producing oil from the well; or for other purposes.

It is another object of the present invention to provide a milling tool, or cutting tool, which may be lowered into the well and whereby the desired portion of the pipe or casing in the well may be cheaply and quickly milled, or cut away and removed.

Another object of the invention is to provide a tool of the character described having a plurality of blades, or cutters, which may be brought into cutting relation with the end of the pipe in succession to the end that as blades become worn or dulled they may be retracted into inactive position and other sharp blades moved into active position in cutting relation with the pipe, all without removing the tool from the well.

Another object of the invention is to provide a milling, or cutting, tool of the character described wherein novel means are provided for actuating the cutting, or milling, blades into active, or inactive position.

With the above and other objects in view the invention has particular relation to certain novel features of construction, operation and arrangement of parts an example of which is given in this specification and illustrated in the accompanying drawings wherein—

Figure 1 shows a fragmentary, vertical sectional view of the milling tool showing one set of blades active and the other inactive.

Figure 2 shows a fragmentary, vertical sectional view of the upper end of the tool showing therein a fishing tool for withdrawing the flow tube.

Figure 3 shows an upper end view of the upper cylinder.

Figure 4 shows a fragmentary side elevation thereof.

Figure 5 shows a fragmentary side view of the flow tube.

Figure 6 shows a cross sectional view thereof taken on the line 6—6 of Figure 5.

Figure 7 shows a fragmentary vertical sectional

view of the tool showing the upper blades active and the lower blades inactive, and

Figure 8 shows a side elevation of the complete tool partly in section showing the blades in position shown in Figure 7.

Referring now more particularly to the drawings wherein like numerals of reference designate the same parts in each of the figures the numerals 1 and 2 designate upper and lower sections of the tubular cutter body, said body being formed of sections screwed together for convenience in construction and assembly. The cutter body has the upper and lower outwardly thickened portions 3 and 4 provided respectively with the upper and lower side slots 5, 5 and 6, 6 which are widened outwardly and downwardly but whose upper margins extend out at substantially right angles to the axis of the body forming the upper and lower shoulders 7, 7 and 8, 8.

Pivotaly mounted in the respective slots are the upper blades 9, 9 and the lower blades 10, 10. These blades are mounted to pivot or rotate on the upper and lower pivot pins 11, 11 and 12, 12 whose ends are anchored to the body.

The slots 5 and 6 are widened outwardly and downwardly so that the blades may be retracted into them when in inactive position as shown in Figures 1 and 7. The blades are extended inwardly beyond their pivots and the inward extension are reduced in width so as to provide sufficient clearance to allow the outer or cutting portion of the blades to be retracted back into the slots when they are in inactive position, as also shown clearly in Figures 1 and 7.

Screwed on to the lower end of the body is an inverted conical shaped guide plug 13 and the upper end of the body is internally threaded for connection to a tubular operating string 14.

Fitted into the upper and lower sections of the body are the upper and lower sleeves which rest on the respective inside upper and lower shoulders 17 and 18. Fitted into the upper and lower sections of the body are the cylinders 19 and 20 whose lower ends are reduced forming the upper and lower external, annular shoulders 21 and 22 which rest on the upper ends of the upper and lower sleeves 15, 15 respectively and said cylinders are clamped in place by the lower end of the string and the lower end of the body section 1, respectively, as shown in Figures 1 and 7. It will be noted that the reduced lower ends of the cylinders are spaced from the sleeves to provide water passageways which are connected into the cylinders by the ports, or ducts, 23, 24 through which fluid may reach the cutting blades to keep

them cool when in operation and to carry away the cuttings.

The lower ends of the cylinder are flared downwardly forming the seats 25, 26, respectively.

Mounted in the upper and lower cylinders are the upper and lower plungers 27, 28. The upper plunger is tubular and has a surrounding seal ring 29 forming a seal with the cylinder and clamped in place by a valve seat 30. The lower cylinder is solid and has a surrounding seal ring 31 forming a seal with the cylinder 20 and clamped in place by a head 32 forming the upper end of said plunger, the parts of the plunger 28 being screwed together as shown in Figure 1.

The lower ends of said plungers are outwardly thickened and flared downwardly externally forming the tapering shoulders 33 and 34 which fit against the corresponding seats 25, 26 when the plungers are in their upper position.

Depending from the lower plunger 28 there is a rod 35 which carries an expander 36 located beneath the inner ends of the blades 10. This expander is seated on a coil spring 37 which in turn rests upon the guide 13 and which normally holds the plunger 28 in its upper position with the shoulder 34 against the seat 22 and with the blades 10 retracted into the slots 6, as shown in Figure 7.

When the blades 10 are in use, as shown in Figure 1, there is a flow tube 38 extended down through the plunger 27 and on through the lower end of the upper body section 1, as shown in Figure 1. The upper end of this tube is outwardly thickened forming a shoulder 39 which rests on the valve seat 30 to support said tube and the inwardly extended end of the cutter blades 9 rest against the tube, as shown in Figure 1, to hold said blades retracted. At this time the shoulder 33 of the upper plunger will rest against the seat 25 of the upper cylinder and the flow tube 38 will be held against upward movement by the latch 40 whose upper end is pivoted in the upper end of the cylinder 19 and whose lower end is formed with the shoulder 41 which engages over the upper end of the tube 38 and which is held in position for such engagement by a spring 42. The range of movement of the latch inwardly is limited by a rod 43 which is attached to the outer margin of the latch and whose outer end is overturned, as shown in Figure 4, to engage a shoulder 44 formed in the cylinder 19. This latch is mounted to move in a radial slot 45 cut in the upper end of the cylinder 19. The inner margin of the latch 40 is formed with the inwardly converging upper and lower tapering faces 46, 47 provided for a purpose to be hereinafter stated.

With the tool assembled, as shown in Figure 1, it may be lowered into the well by the operation string 14 until its lower end enters the pipe or casing 48 to be milled away and pressure may be applied to the fluid downwardly through the string and tube 43 against the plunger 28 forcing said plunger downwardly against the inner ends of the blades 10 forcing the outer ends of said blades upwardly and outwardly until they engage the shoulders 8 at which time their lower edges will be in approximately horizontal position, said blades extending outwardly beyond the pipe 48 and the tool may then be let down until said blades come into contact with said upper end and the tool then rotated with sufficient weight on it to cause the blades to mill or cut away the pipe. The weight of the tool on the blades may be properly regulated by conventional draw works

or other suitable equipment at the ground surface.

Flushing fluid will be supplied to the blades 10 through the ducts 24 and on around the cylinder 20.

When the blades 10 become dull or should they become broken or worn out the tool may be elevated and the pressure relieved whereupon the blades 10 will be retracted by the pressure of the spring 37 in an obvious manner, and as shown in Figure 7.

Thereupon the flow tube 38 may be withdrawn and pressure reapplied to force the plunger 27 downwardly. It may be found desirable to drop a ball valve 49 onto the seat 30 to close it, as shown in Figure 7. As the plunger 27 is forced downwardly it will engage the extended inner ends of the blades 9 and force the outer ends of said blades outwardly and upwardly until they engage the shoulder 7. At the same time the inner ends of these blades will engage the shoulder 50 beneath, as shown in Figure 7, and the cutting edges of the blades 9 will be in horizontal position. At this time there will be no substantial pressure on the plunger 28 so that the blades 10 will remain retracted but if the pressure should force the plunger 28 downwardly the dulled or worn blades 10 will only engage against the inside of the pipe 48 without injury to the tool or interference with the milling operation.

When the blades 9 are moved outwardly to active position the tool may then be lowered and rotated as before and the milling operation proceeded with.

In order to allow the plunger 27 to be moved downwardly by the fluid pressure the flow tube 38 should be displaced. This may be done in various ways but as shown a special tool has been provided for withdrawing the flow tube. This tool comprises a cylindrical body 51 having a cone shaped head 52 on the upper end thereof engageable by a conventional grappling tool 53 which may be let down into the well, and withdrawn by a cable. The lower end on the body 51 is reduced and formed with an annular groove 54 therearound.

The upper end of the flow tube has a transverse slot 55 cut therein wherein there is mounted a spring actuated latch 56 which is normally held inwardly by the spring 57.

When the withdrawing tool is let down into the well its lower end will engage the face 45 and retract the latch 40, disengaging the shoulder 41 from the upper end of the flow tube and will move on down retracting the latch 56 until said latch registers with the groove 54 whereupon the latch will snap into said groove and upon withdrawal of the special tool the flow tube will be withdrawn with it and the valve 49 may then be dropped in place.

What I claim is:

1. A tool of the character described comprising a body adapted to be connected to a tubular operating string, an upper and a lower cutter mounted on the body and movable into active position to operate on a pipe in a well to cut away and remove a portion of the pipe and also movable into retracted, or inactive, position, separate, independently operable, means in the body operable by fluid under pressure to actuate said cutters into said active position, and means in the body effective to hold one cutter inactive while the other cutter is active.

2. A tool of the character described comprising a body adapted to be connected to a tubular op-

erating string, an upper and a lower cutter mounted on the body and movable into active position to operate on a pipe in a well to cut away and remove a portion of said pipe and also movable to inactive, or retracted, position, independent plungers in the body movable by the pressure of an operating fluid and arranged to actuate the corresponding cutters into active position, and means to maintain one cutter inactive while the other cutter is active.

3. A tool of the character described comprising a body adapted to be connected to a tubular operating string, an upper and a lower cutter mounted on the body and movable into active position to operate on a pipe in a well to cut away and remove a portion of said pipe and also movable to inactive, or retracted, position, independent plungers in the body movable by the pressure of an operating fluid and arranged to actuate the corresponding cutters into active position, a flow tube extended through the upper plunger through which the operating fluid may flow to the lower plunger.

4. A tool of the character described comprising a body adapted to be connected to a tubular operating string, an upper and a lower cutter mounted on the body and movable into active position to operate on a pipe in a well to cut away and remove a portion of said pipe and also movable to inactive, or retracted, position, independent plungers in the body movable by the pressure of an operating fluid and arranged to actuate the corresponding cutters into active position, a flow tube extended through the upper plunger through which the operating fluid may flow to the lower plunger and releasable means for locking the flow tube in position.

5. A tool of the character described comprising a body adapted to be connected to a tubular operating string, an upper and a lower cutter mounted on the body and movable into active position to operate on a pipe in a well to cut away and remove a portion of said pipe and also movable to inactive, or retracted, position, an upper and a lower plunger in the body movable by the pressure of an operating fluid and arranged to actuate the corresponding cutters into active position, means associated with the lower plunger and including a yieldable member arranged to move the lower cutter to inactive position upon relief of said pressure.

6. A tool of the character described comprising a body adapted to be connected to an operating string, an upper and a lower cutter mounted on the body and movable into active position to operate on a pipe in a well to cut away and remove a portion of said pipe and also movable to inactive, or retracted, position, plungers in the body movable by the pressure of an operating fluid and arranged to actuate the corresponding cutters into active position, releasable means for holding the upper cutter inactive and formed to allow pressure fluid to act on the lower plunger to render the lower cutter active.

7. A tool of the character described comprising a body adapted to be connected to an operating string, an upper and a lower cutter mounted on the body and movable into active position to operate on a pipe in a well to cut away and remove a portion of said pipe and also movable to inactive, or retracted position, upper and lower cylinders in the body, upper and lower plungers in the cylinders movable by the pressure of an operating fluid and arranged to actuate the corresponding cutters into active position.

8. A tool of the character described comprising a body adapted to be connected to an operating string, an upper and a lower cutter mounted on the body and movable into active position to operate on a pipe in a well to cut away and remove a portion of said pipe and also movable to inactive, or retracted position, upper and lower cylinders in the body, upper and lower plungers in the cylinders movable by the pressure of an operating fluid and arranged to actuate the corresponding cutters into active position, removable means for bypassing the pressure fluid around the upper plunger to the lower plunger to actuate the lower cutter and means for holding the lower cutter inactive upon removal of said bypassing means and the application of fluid pressure to upper plunger to move the upper cutter to active position.

9. A milling tool adapted to cut by rotation and comprising a body adapted to be connected to a tubular operating string, an upper and a lower set of cutters mounted on the body and movable into active position to operate on a pipe in a well to cut away and remove a portion of said pipe and also movable to inactive or retracted, position, upper and lower cylinders in the body, upper and lower plungers in the cylinder movable by the pressure of an operating fluid and arranged to actuate the corresponding cutters into active position and means in the tool for directing the application of the fluid pressure to the lower and upper plungers in succession to successively actuate the lower and upper cutters into active position.

10. A tool of the character described comprising a body adapted to be connected to a tubular operating string, an upper and a lower cutter mounted on the body and movable into active position to operate on a pipe in a well to cut away and remove a portion of said pipe and also movable to inactive, or retracted, position, independent plungers in the body movable by the pressure of an operating fluid and arranged to actuate the corresponding cutters into active position, a flow tube extended through the upper plunger through which the operating fluid may flow to the lower plunger and means including a line extended to the ground surface through which the flow tube may be withdrawn from the tool.

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