March 30, 1948. T. E. McMAHAN 2,438,673

WELL TOOL

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Fig. 1.

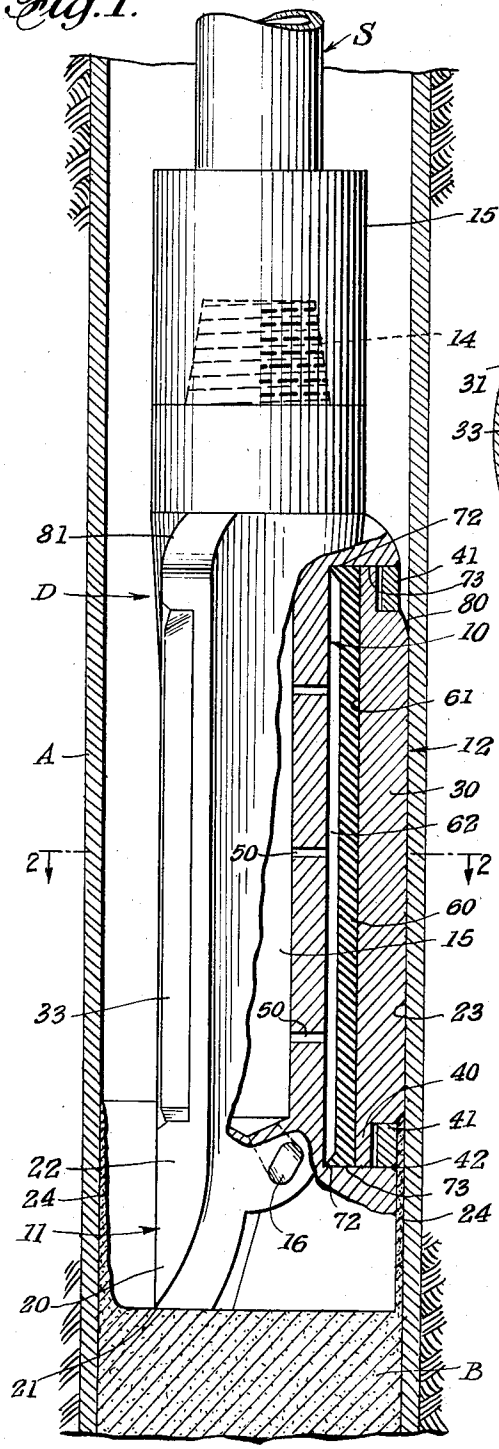
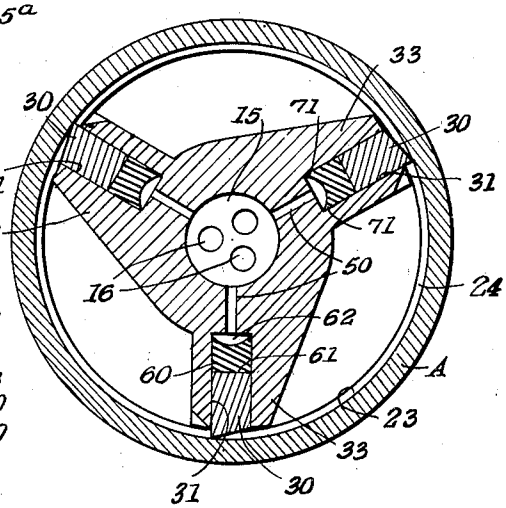


Fig. 2.



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WELL TOOL

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1 Claim. (Cl. 166—18)

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This invention has to do with a well tool with laterally shiftable blades and it is a general object of the invention to provide a tool of that type which is simple, effective, and dependable.

The tool or construction of the present invention is designed to be rotated in a well and is useful, generally, in well operations as, for instance, for reaming, scraping, or like operations. For example, the construction of the present invention can be used to advantage in well reamers or in scrapers and it is particularly useful in scrapers to be used within a casing or well liner.

This application is a continuation in part of my application entitled "Bit for cleaning well casing," Serial No. 535,599, filed May 15, 1944, now abandoned.

A typical cementing operation requires that a suitable slug or body of cement be left in the lower end portion of the casing being set and when the setting period has terminated tools are run in the casing to drill out this slug of cement. Ordinary drilling bits can be used for this purpose, but are not altogether effective as they will not always remove all of the cement.

It is a general object of my present invention to provide a well tool with laterally operable or shiftable members, such as scrapers or cutters, which members are actuated by fluid pressure. By my present invention I provide laterally shiftable members that may be cutter or scraper blades, and I operate those members into active cutting position by means of fluid pressure.

Another general object of my present invention is to provide a tool of the general character hereinabove referred to which employs the usual circulating fluid as the medium for actuating the cutters. By my present invention the circulating fluid employed to flush the cuttings from the well also acts to expand the blades which act as cutters or scrapers.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a view showing a typical well tool embodying the present invention, the tool being a combined bit and scraper, parts being broken away to illustrate the construction provided by the present invention;

Fig. 2 is an enlarged detailed transverse sectional view taken as indicated by line 2—2 on Fig. 1.

In the drawings I show a well casing A con-

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taining a body or slug of cement B and I show the tool D of the present invention on the lower end of an operating string S and being operated to remove the cement from the casing.

The tool which I have shown embodying the laterally shiftable members of the present invention involves, generally, an elongate body 10, cutting means 11 on the lower end of the body designed to be advanced into the cement B and to cut away a substantial portion thereof, and cutting means 12 projecting laterally from the body above the means 11 to remove cement that may be left after the advance of the means 11 or to cut or ream any formation at the side of the tool. The cutting means 12 of the present invention comprises one or more blade-like members which may be designed or fashioned to have the desired cutting or scraping action at the side of the tool.

The body 10 is preferably an elongate member substantially round in cross section and is provided at its upper end with means for making connection with the string S which may be a string or drill pipe, or the like. In the case illustrated the body 10 is provided at its upper end with a threaded pin 14 for making connection with a box member 15a on the lower end of the string of drill pipe. A central longitudinal circulation opening 15 extends through the body 10 and suitably disposed discharge openings 16 are provided at the cutting means 11 so that circulating fluid discharge downwardly through the drill string S passes through the body 10 and issues at the lower end thereof, or at the means 11, to effectively flush away cuttings made by the means 11. Where the cutting means 11 involves a plurality of blades, as will be hereinafter described, it is usually advantageous to provide a corresponding number of discharge openings for the circulating fluid so that each blade is effectively flushed. It is advantageous that the circulating fluid issue at a high velocity in order to effectively keep the cutting parts clean and to wash away the cuttings and, therefore, the combined areas of the several discharge openings 16 is made less than the capacity of the opening 15 through the body. Through this relationship of parts the openings 16 serve as a restriction and act to build up pressure of circulating fluid within the body 10 which I utilize as will be hereinafter described.

The cutting means 11 provided at the lower end of the body may be varied considerably as circumstances require, or to satisfy the desires of the operator. In the case illustrated I have shown a drag type bit construction at the lower

end of the tool and this bit construction involves three cutting blades 20 spaced around the axis of the tool and projecting downwardly from the lower end of the body 10. The blades have lower cutting edges 21 dressed or finished to effectively act on the formation or material to be cut. The cutting means 11 as above described is a fixed or rigid cutting means and to facilitate free passage of the tube through the casing A, or through a like part, the blades 20 are limited as to their radial extent so that there is clearance between their outer sides 22 and the inner wall 23 of the casing. This clearance is made sufficient to allow for normal obstructions that may occur in the casing or that might tend to prevent passage of the tool if the fixed diameter of the tool were larger.

As a result of the proportioning just described the means 11 acts to cut away the main bulk or body of cement B but leaves a thin wall or layer 24 of cement between the outer sides 22 of the cutters and the wall 23 of the casing. If the bit is operating centrally in the casing the layer 24 of cement will be a uniform thin wall such as is indicated at the right in Fig. 1 of the drawings. This thin wall of cement is, with ordinary tools, left in the casing and may seriously interfere with or impair subsequent well operations.

The cutting means 12 is provided in the particular tool being illustrated as a means to scrape or cut away the layer 24 of cement left in the casing, and it is designed to do this by a scraping action.

The cutting means 12 actuated through the construction provided by my present invention is shown as embodying a plurality of cutting blades, say for instance three blades 30 disposed longitudinally of the tool and equally spaced around the axis of the tool. The blades are carried in guideways 31 provided in the body 10 so that they are movable radially or outward to engage the wall 23 of the casing. The outer edge portions of the blades are sharpened or dressed to have the desired cutting action. In the case illustrated the guideways 31 are located in ribs 33 which project from the exterior of the body and which extend longitudinally of the body. The guideways 31 are channel-like openings extending into the body from the outer end portions of the ribs and in the form of the invention illustrated the guideways have parallel flat side walls between which the blades 30 operate. The blades are slidably fitted between the side walls of the guideways so that they are effectively held and yet operate with suitable freedom.

In practice means are provided for retaining the blades in position in the guideways or for limiting outward movement of the blades. In the particular construction illustrated lugs or ears 40 project from the ends of the blades and stop blocks 41 are secured or fixed in the ends of the guideways to overlie the ears, as clearly shown in Fig. 1 of the drawings. The ears and stops are related or proportioned so that the blades have the desired amount of free movement radially, this movement being such as to assure free operation of the blades to an out position where they will have the desired cutting or scaping action. The stop or limiting means just described may vary widely in practice. However, it is practical to form the lugs or ears 40 integrally on the ends of the blades and to make the stop blocks in the form of separate parts arranged in place in the ends of the guides to be secured in position by welding 42.

My present invention is primarily concerned with the construction whereby the blades or members 30 are operated to the extended position to have the desired cutting action. In accordance with my invention I provide one or more fluid passages 50 from the fluid circulation opening 15 of the body to each guideway 31. The passages 50 communicate with the inner end portions or bottoms of the guideways and thus serve to admit fluid pressure behind the members 30 so that it acts to normally press the members 30 outwardly or to active working position. Since there is a back pressure built up in the circulation opening 15 provided in the body 10 for the reasons hereinabove pointed out, the pressure admitted behind the members will normally tend to press or urge them outwardly.

To assure effective operation of the members 30 and to prevent leakage of circulating fluid at the members 30 I prefer to provide a sealing means in connection with each member or blade 30. In the preferred form of the invention I provide a strip 60 of sealing material behind each member 30. Each sealing strip 60 preferably seats against the inner wall 61 of a blade and is proportioned so that there is a space 62 between the sealing strip and the bottom 63 of the guideway. This space is occupied by circulating fluid introduced through the passages 50. The sealing means or the sealing strip above referred to may be formed of various materials and may be of various constructions. However, I prefer in practice to form it of rubber or rubber-like material not attacked by materials present in a well, and I prefer to form it so that it has sealing lips at its margins which serve to effectively prevent leakage of circulating fluid. In the particular form of the invention illustrated the inner side 70 of the sealing strip is made concave in cross section when viewed as shown in Fig. 2, so that it presents sealing lips 71 that effectively bear against the sides of the guideway 31. Sealing lips 72 are formed at the ends of the sealing strip to effectively seal against the ends 73 of the guideway.

In order to facilitate retraction or depression of the blade members 30 as when the tool is being withdrawn from the well, it is preferred to bevel or round the projecting corners 80 of the blades and it is also desirable, in practice, to round the ends 81 of the ribs 33.

In operating the particular tool hereinabove described the cutting means 11 cuts the major portion of the cement away and as this operation is being performed circulating fluid is constantly forced down through the drilling string S to issue from the openings 16. The back pressure established in the passage or opening 15 is exerted upon the blades 30 through the sealing strips 60 and consequently the blades are kept tight against the inner wall 23 of the casing. In a case where the invention is employed in a tool other than that above described the circulating pressure will maintain the members 30 in an out position to ream, scrape, or cut, as the case may be.

With the tool illustrated the drilling and scraping operation will proceed so long as the tool is rotated and advanced with circulation fluid being forced down through the drill pipe. When it is desired to withdraw the tool it is merely necessary to pull it up through the casing and, if desired, circulation can be stopped or cut down, as circumstances require. Ordinarily, however, the beveled corners 80 of the blades will serve to

cause the blades to be depressed, even though the circulation fluid may be urging them out.

Having described only a typical preferred form and application of the invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art and fall within the scope of the following claim.

Having described my invention, I claim:

A tool of the character described including an elongate body to be rotated by a well string, there being a longitudinal fluid passage in the body and restricted outlet passages at the lower end of the body, a blade having an edge, a rib projecting from the side of the body forming a guideway carrying the blade so its edge faces in the direction of rotation of the body, there being a passage connecting the said fluid passage and the guideway, and a sealing member in the guideway behind the blade, the rib extending to the lower end of the body and there having an edge facing in the direction of rotation of the body.

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