

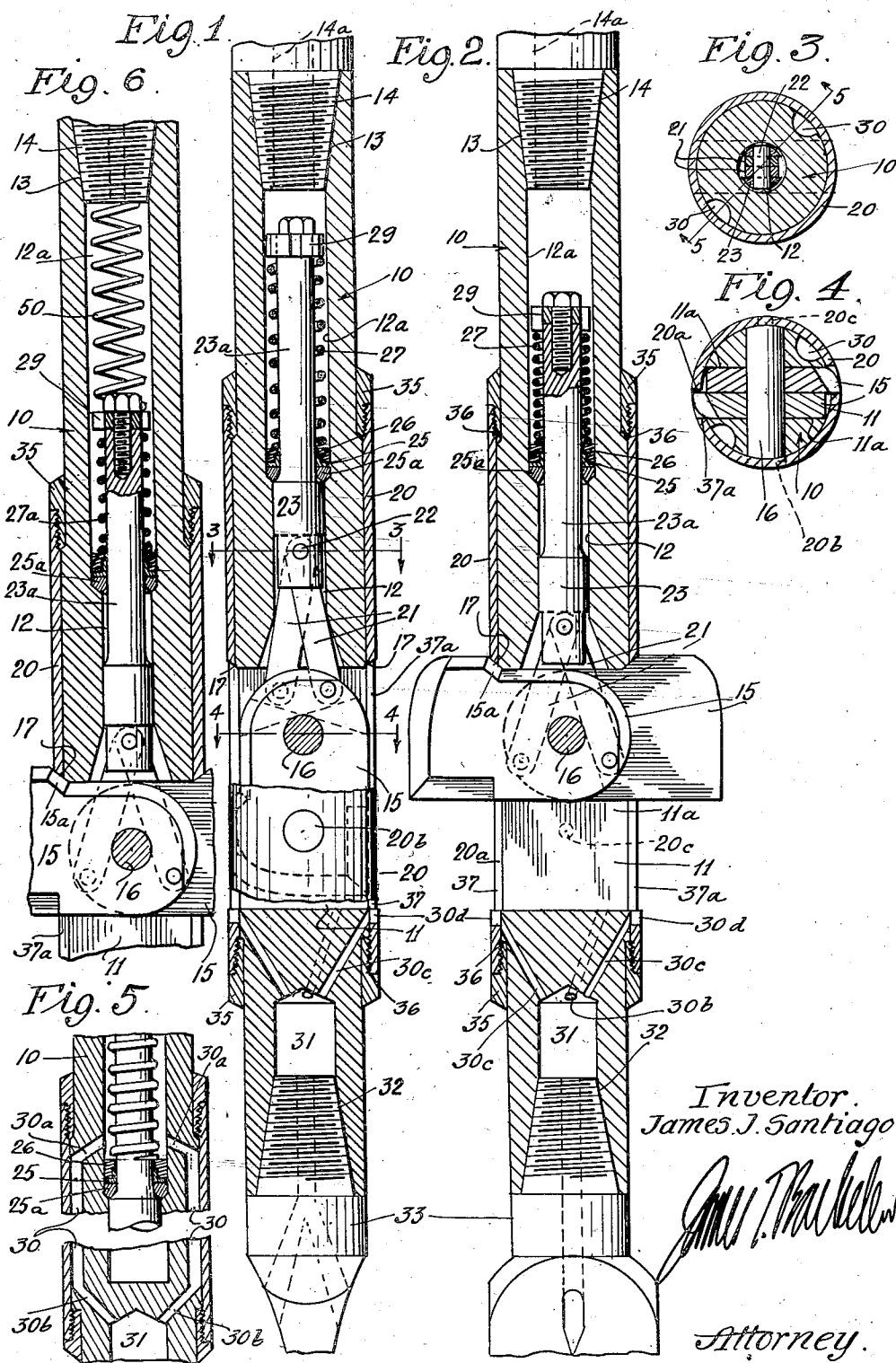
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REAMER AND WELL SCRAPER

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REAMER AND WELL SCRAPER

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9 Claims. (Cl. 255-76)

This invention has to do with tools for reaming, scraping or cleaning a well bore; and relates more particularly to a tool wherein the cutters are held in and project from a transverse slot through the body, or to an expanding tool of the type utilizing blades which move laterally for expansion and contraction in a transverse slot cut through the reamer body. A typical structure and arrangement of such blades is one involving a transverse blade pivot on which the blades swing like wings; and it is in connection with such typical arrangement that I shall explain my invention, although the invention, as will be seen from what follows, is not necessarily restricted to expansion or to that particular type of expansible movement.

In reamers of the type referred to, the blades may be moved to their expanded positions by various suitable means, such as by hydraulic action or by a spring; and my invention is applicable regardless of the type of blade actuating means or element.

The general object of my invention is to provide a structure, peculiarly adaptable to a transversely slotted body, to the end of materially strengthening the body, holding twist-offs, and further to adapt a given sized body to various diameters without the necessity of having to provide a complete tool or complete body for each of the diameters desired.

In accomplishing such objects, my invention provides the slotted and usually cylindric body with an exterior sleeve locked lengthwise upon the body, fitting the body snugly but not so tightly that, in case of twist-off, the broken part of the body cannot turn within the sleeve; and the sleeve being so mounted upon the body as to be substitutable in different sleeve thicknesses so as to vary the effective external diameter of the body to suit different sized bore holes. The sleeve also forms a wall for the circulation passage which, in order to by-pass the body slot, is conveniently formed as a groove in the face of the body. All these, and other objects and corresponding accomplishments, and the full details of preferred forms and applications of the invention will be understood from the following specification wherein reference is had to the accompanying drawing in which:

Figure 1 is a longitudinal central section showing one form of my improved tool in its collapsed condition;

Fig. 2 is a similar view showing the same tool in expanded condition;

Fig. 3 is a cross section on line 3-3 of Fig. 1;

Fig. 4 is a cross section on line 4-4 of Fig. 1;

Fig. 5 is a fragmentary longitudinal section on line 5-5 of Fig. 3; and

Fig. 6 is a view showing a modification wherein the cutters are expanded by spring action rather than by hydraulic action as in Figs. 1 and 2.

In the drawing I show at 10 a cylindric body having a transverse cutter slot 11 therethrough and, above the slot, a bore 12, enlarged above as at 12a. At the upper end of bore 12a is the usual threaded box 13 to take pin 14 of a tool joint connecting the tool with a sub or with the rotary drill stem or pipe; any of which have the circulation passage 14a which communicates with the bore 12a.

Mounted in the transverse cutter slot 11 are shown two pivoted cutter blades 15, of the type I here prefer to illustrate. These two blades lie alongside each other, face to face, in slot 11 and move pivotally between the collapsed positions shown in Fig. 1 and the expanded positions shown in Figs. 2 and 6; moving thus pivotally on the transverse pivot pin 16. The exact shapes, and cutting edge configurations, of these cutters may be made as desired; and also their amount of projection beyond the body when expanded. Usually they may be provided with sharpened edges; but any other type of final cutting element may be carried by the blades. Each blade has, in its upper edge, an inwardly, and preferably inwardly and upwardly facing surface 15a adapted, when the blades are expanded, to bear inwardly, and preferably also upwardly, against correspondingly placed bearing surfaces 17 on the body, or exterior sleeve 20, or both the body and sleeve. The purpose of these inward and preferably also upward bearings is to take directly to the body a major part of the reaction thrusts exerted upon the cutters by the walls being cut. It will be understood that, as the tool is rotated and lowered progressively, the reaction thrust of the wall upon the cutter is upwardly and inwardly, as well as circumferentially; and these shoulder bearings take that reaction thrust and thus largely relieve the pivot pin 16 from the heavy inward thrusts to which it would otherwise be subjected.

To operate the cutters I have shown a pair of connecting links 21 pivoted one to each of the cutters, and both pivotally connected above at 22 to an actuating plunger 23 whose upper stem 23a projects into the enlarged bore 12a. Surrounding stem 23a at the lower end of bore 12a is a suitable packing 25 surmounted by a pres-

sure ring 26 on which the cutter retraction spring 27 is seated; the spring pressing on ring 26 tending to compress the packing and thus keep it tight. Packing 25 is preferably a flanged ring of leather or the like, resting on a supporting ring 25a seated in the bottom of bore 12a; and the spring seat ring 26 preferably conforms to the shape of the flanged packing ring, so as to hold it against plunger 23a. The upper end of spring 27 is pressed upwardly against a peripherally notched head 29 mounted on the upper end of stem 23a. The purpose and function of the spring 27 is to raise the plunger and throw the cutters to collapsed position. When the cutters reach expanded position, the lower enlarged part of plunger 23 engages ring 25 and thus stops further spring action just as the cutters reach the fully collapsed position. This action, and the fact that each cutter swings back against the inside surface of the sleeve (see Fig. 4) prevents the cutters from swinging beyond collapsed position. The cutters are moved to expanded position by hydraulic pressure of the circulating fluid which passes down into the upper bore 12a and then passes restrictedly by the head 29 to reach the upper ends of the circulation passages 30 which communicate with bore 12a somewhat above packing 25 but below the lowermost position of head 29. The slotting of head 29 is for the purpose of providing a restricted passage for the circulating fluid allowing the circulating fluid to reach the circulation passages 30 but at the same time to exert a sufficient downward pressure on head 29 to move the head downwardly, and hold it downwardly so as to hold the cutters in expanded positions as long as circulation is kept up.

The circulation passages 30 are formed as longitudinal grooves in the exterior surface of body 10, and covered by sleeve 20; except where at 30a and 30b they are bored diagonally through the body to communicate with bore 12a and with lower body bore 31 above the tool joint pin 32 of the fluid passaged bit 33 which is attached to the lower end of the body. By this preferred arrangement of fluid passages a simple fluid communication lengthwise through the body is obtained, and one which by-passes the transverse slot 11; but other suitable specific arrangements may be used, such for instance as the longitudinally bored passage entirely contained within the body proper, but close to its wall, such as shown in my prior Patent 1,555,365, dated September 29, 1925. To deliver circulating fluid upwardly under cutters 15, auxiliary passages 30c lead from lower bore 31 upwardly and outwardly to the body exterior at the bottom of the body slot, notches being cut at 30d in the sleeve at the bottoms of its slots 37 to clear the upper ends of passages 30c.

The exterior sleeve 20, hereinbefore referred to, surrounds the central portions of the body and particularly its slotted part. This sleeve is locked longitudinally to the body by means of screw-thread bushings 35 which bear oppositely against endwise facing body shoulders 37; so that the sleeve may be mounted upon or removed from the body by screwing in or unscrewing these threaded bushings. The sleeve has, through its wall, slots 37 registering with the body and acting, like the body slot, to confine the cutters in their face to face engagement, and thus to provide extended bearing faces against which the flat cutter faces bear under the rotary thrust imposed upon them in use. It will be noted from Figs. 1 and 2 that the sleeve slots register in length with the body slot,

and from Fig. 4 that they register each along one side with one side of the body slot. Each sleeve slot is substantially just wide enough to pass one cutter, so that, when the cutters are extended and the tool rotating right-handedly, each cutter bears back on its rear face flatly against a wall surface 11a of the body slot and a surface 37a of a sleeve slot, and is held back in such bearing by the part 20a of the sleeve which overhangs half of the body slot. This arrangement can be best understood from consideration of Fig. 4.

Sleeve 20 may be of any suitable thickness; so that by substituting sleeves of different thicknesses, the effective external diameter of the body may be increased or decreased without any change having to be made in the body proper. Thus any given tool may be used in different sized bore holes simply by changing the external sleeve. To remove a sleeve one or both of the bushings 35 is removed, when the sleeve may be slid lengthwise off the body, after pivot pin 16 and cutters 15 are removed, holes 20b and 20c being provided in the sleeve for allowing the pin to be punched out. To prevent accidental removal of the pivot pin it may be fitted tightly in the body or locked by any suitable known locking means. On the other hand, by making the cutters somewhat narrower than is shown in the drawing, so that when hanging down they clear the interior of the sleeve, then the sleeve may be removed without first removing the cutters. And in that case the sleeve holes 20b and 20c are not needed and the sleeve becomes a lock preventing accidental displacement of the pivot pin.

It is preferred, however, to make the cutters wide enough that they project into the sleeve slots when collapsed; the sleeve being thus prevented from rotating on the body, and the cutters being of maximum width and strength. In such an arrangement the cutters must be removed before the sleeve can be removed, and the holes 20b and 20c must be provided in the sleeve for removal of the cutter pin 16. In order to make the sleeve in its normal position lock the cutter pin in place, the holes 20b and 20c are positioned so that they are normally below the pin, as is shown in Figs. 1 and 2. In this position of the sleeve the pin 16 is completely covered at both ends and therefore cannot be displaced. To remove the pin, the sleeve is lifted to register holes 20b and 20c with the pin. This can be done with the cutters in the position of Fig. 2, the length of sleeve slots 37 below the cutters allowing the sleeve to be raised to said registering position. The pin 16 may then be driven out, the cutters removed, and the sleeve then removed from the body.

The sleeve is fitted to the body snugly, preferably as tightly as is consistent with fair ease of placement and removal; but is not fitted so tightly to the body that it will not allow relative rotation of body parts in case the body should be twisted off at the slot. These slotted bodies are weakest at the slot, and at that point the twist-off is most likely to occur. Thus, in my construction, should the lower end of the body part from the upper end at a point below the cutters, the lower end of the body may swivel in the sleeve, and thus take the rotational strain off the sleeve so that the unbroken sleeve will still hold the lower end to remove it from the hole. And should the body part above the cutters at the upper end of the slot, then the upper part of the body member may swivel in the sleeve, and again the whole tool may be pulled out of the well. In order to fa-

facilitate such swivelling, in case of an irregular break across the body, it may not be objectionable to locate the upper bushing 35 somewhat above the corresponding body shoulder 36 so as to leave some clearance for lengthwise movement of the broken body parts in the sleeve. This clearance is shown in Fig. 2. In such a case the fairly tight fit of the sleeve on the body keeps the sleeve from being displaced downwardly by its own weight.

The forms previously described utilize hydraulic pressure for expanding the cutters. In Fig. 6 a cutter expanding spring 50 is used in lieu of or in addition to hydraulic pressure. This spring presses downwardly upon the plunger stem 23a with sufficient force to forcibly move the cutters downwardly as soon as they pass below the casing and to expand them to the position of Fig. 2 when the cutters have found a cavity or as soon as the cutters have cut an opening large enough to expand in. In this form of Fig. 6 a lighter spring 27a may still be used in the position of the spring 27, but merely for compressing the packing. Otherwise the form of Fig. 6 is the same as before described.

From a consideration of the form of device shown in Fig. 6 it will be readily understood that my invention is not limited to a hydraulically expanded tool; but that on the other hand the cutters may be expanded by any suitable force or action. And from a consideration of the general nature of the invention, residing as it does largely in the sleeve and its appurtenances, it will now be understood how and why the invention is not limited to the particular form of swinging cutters herein described. The cutters may move in other manners for expanding and contracting purposes. And in a still broader aspect of the applicability of my invention, it is immaterial whether the cutters are expansively movable. The sleeve and its appurtenances are applicable to a non-expansive reamer in which the cutters project fixedly from the body and through the sleeve slots.

This application is a continuation in part of my previous application Ser. No. 665,377, filed April 10, 1933, Reamer or well scraper.

I claim:

1. A reaming tool, comprising a vertically extending substantially cylindric body having in a medial portion a transverse cutter-receiving slot extending therethrough, cutters mounted in the body slot and projecting therefrom beyond the side surface of the body, a body reinforcing sleeve fixed longitudinally on and closely surrounding the body from a point above its slotted portion to a point below that portion, the upper end of the body having a rotary drive connection, and the sleeve having slots through which the cutters project outwardly and being revoluble on the body so as to form an interconnecting swivel member between the upper and lower body portions in event of body rupture at its slotted portion.

2. A reaming tool, comprising a vertically extending substantially cylindric body having in a medial portion a transverse cutter-receiving slot extending therethrough, cutters mounted in the body slot and projecting therefrom beyond the side surface of the body, a body reinforcing sleeve closely surrounding the body from a point above its slotted portion to a point below that portion, the body having an upwardly facing shoulder above its slotted portion and a downwardly facing

shoulder below said portion, and means in association with the sleeve ends bearing upon said body shoulders to limit longitudinal movement of the sleeve on the body, the upper end of the body having a rotary drive connection, and the sleeve having slots through which the cutters project outwardly and being revoluble on the body so as to form an interconnecting swivel member between the upper and lower body portions in event of body rupture at its slotted portion.

3. A reaming tool comprising a vertically extending substantially cylindric body having in a medial portion a transverse cutter-receiving slot extending therethrough, a pair of flat blade-like cutters mounted in the slot, said cutters bearing laterally against each other and each bearing laterally against a vertical side wall of the slot, the cutters extending outwardly beyond the outer surface of the body at opposite sides of the body, each cutter so extending beyond one side only, a body reinforcing sleeve removably fixed longitudinally on and closely but revolubly surrounding the body from a point above its slotted portion to a point below its slotted portion, the sleeve having slots just substantially wide enough to pass the outwardly projecting parts of the two cutters and the opposite side walls of each sleeve slot thus bearing on opposite faces of one cutter.

4. A reaming tool, comprising a vertically extending substantially cylindric body having a cutter-receiving opening therein, a cutter securing pin extending transversely through the body and through the cutter opening with an end exposed at the outer surface of the body, a cutter in the opening mounted on the pin, and a body reinforcing sleeve closely surrounding the body, having a slot registering with the body opening and through which the cutter projects, said sleeve being removably mounted on the body and covering the pin end to prevent its displacement.

5. A reaming tool comprising a vertically extending substantially cylindric body having in a medial portion a transverse cutter-receiving slot extending therethrough, a pair of flat blade-like cutters mounted in the slot, said cutters bearing laterally against each other and each bearing laterally against a vertical side wall of the slot, the cutters extending outwardly beyond the outer surface of the body at opposite sides of the body, each cutter so extending beyond one side only, a body reinforcing sleeve removably fixed longitudinally on and closely but revolubly surrounding the body from a point above its slotted portion to a point below its slotted portion, the sleeve having slots just substantially wide enough to pass the outward projecting parts of the two cutters and the opposite side walls of each sleeve slot thus bearing on opposite faces of one cutter, a cutter securing pin extending transversely through the body and through the cutters in the cutter-receiving slot, an end of the pin being exposed at the outer surface of the body, and the sleeve covering the pin end to prevent its displacement.

6. A reaming tool, comprising a substantially cylindric body, a cutter mounted in the body and projecting therefrom, the body having in its end portions fluid circulating passages connectible with a drill stem and tools, and having at its upper end a rotary drive connection tool to such drill stem, the body having a fluid passage in the form of a superficial groove extending along its outside surface and connecting said end passages, and an external reinforcing sleeve closely but removably surrounding the body and closing the

grooves to form closed passages, the sleeve having a slot through which the cutter may project, and releasable means for holding the sleeve fixed lengthwise with relation to the body.

5 7. A reaming tool, comprising a substantially cylindric body having a cutter receiving opening, a cutter therein, a cutter securing pin extending transversely through the body with an end exposed at the outer surface of the body, a sleeve surrounding the body and having a slot through
10 which the cutter may project, means normally holding the sleeve against movement on the body, the sleeve having a pin passing opening normally out of register with the cutter securing pin but
15 movable into register with it by movement of the sleeve on the body.

8. A reaming tool, comprising a vertically extending substantially cylindric body having a cutter receiving opening, a cutter therein, a cutter
20 securing pin extending transversely through the body with an end exposed at the outer surface of the body, a sleeve surrounding the body and having a slot through which the cutter may project, means normally securing the sleeve against

lengthwise movement on the body, the sleeve having a pin passing opening normally out of register with the cutter securing pin but movable into register with it by longitudinal movement of the sleeve.

9. A reaming tool, comprising a vertically extending substantially cylindric body having a cutter receiving opening, a cutter therein extending beyond the outer face of the body, a cutter securing pin extending transversely through the body with an end exposed at the outer surface of the body, a sleeve surrounding the body and having a slot into which the cutter projects and thereby prevents relative rotation of the sleeve on the body, the sleeve slot being long enough to allow a limited relative longitudinal movement of the sleeve on the body, means normally holding the sleeve against longitudinal movement on the body, and the sleeve having a pin passing opening normally out of register with the cutter securing pin but movable into register with it by the limited relative longitudinal movement permitted by the cutter.

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