

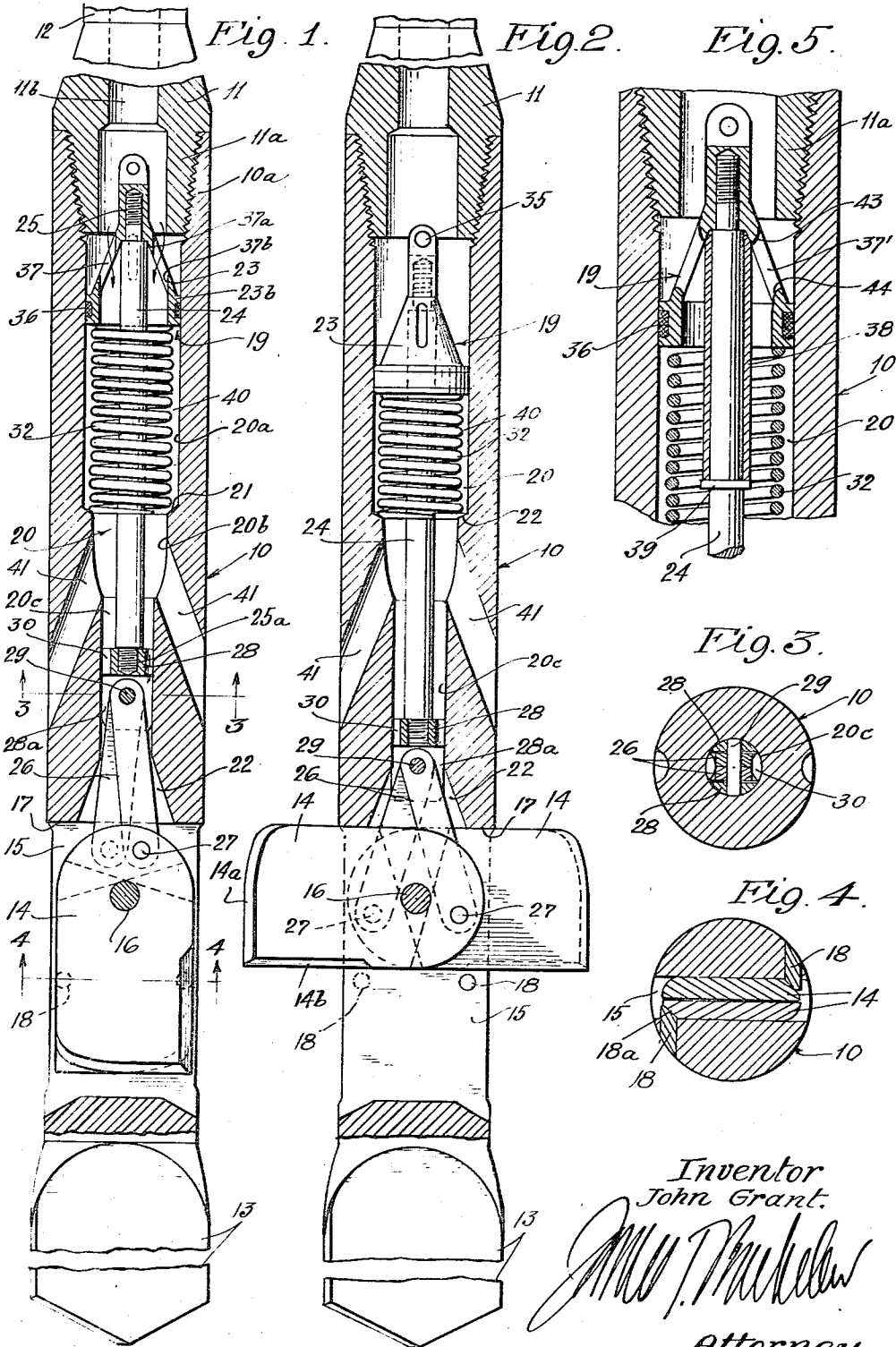
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WALL SCRAPER

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## WALL SCRAPER

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This invention relates generally to well reaming or scraping tools embodying expansible reaming elements or cutters, and particularly to tools of this type in which the cutters are actuated by circulating fluid pressure. My invention is primarily directed to improvements in the fluid circulating system in the tool, and provisions whereby excessive wear and abrasion of the parts by the circulating fluid is prevented. While I have chosen as a typical and preferred embodiment of the invention, a type of reaming tool in which the cutters take the form of blades mounted within a transverse slot in the body, it will be understood that in its broad aspects the invention is not limited to any particular type of cutters or cutter arrangement.

The present reaming tool may be generally described as comprising a tubular body containing a plunger connected to the cutters and actuated by circulating fluid to move the cutters to expanded positions. As regards the general construction and arrangement of the parts, the present tool is similar to that described in Patent No. 1,992,546, issued February 26, 1935, to James J. Santiago, on Reamers and well scrapers. In the operation of the tool the plunger is pressed downwardly by the fluid pressure and, in order to maintain the desired circulation of fluid into the well in proper proximity to the cutters or a drilling tool carried below the reamer, the circulating fluid is conducted downwardly through passages in the plunger, the fluid passages being restricted sufficiently to maintain the necessary operating pressure differential on the plunger. In practice, serious difficulty has resulted from excessive wear on the parts through which the restricted fluid passages extend, due to the abrasive action of the high velocity circulating fluid and the fine mud or siliceous particles which it carries.

My primary object is to provide improvements in the construction of the cutter actuating plunger and the positions and arrangement of the circulating fluid passages in the plunger, to the end that ample pressure differentials may be maintained to operate the plunger, without involving excessive fluid velocities through the restricted passages and resultant excessive wear on the parts. The invention also provides a novel arrangement of fluid passages in the body of the tool, which enable the circulating fluid to be discharged at the most desirable points for effective operation of the tool.

The manner in which these and additional objects are accomplished by the invention, will be

made clear in the following detailed description of the invention in one of its typical and preferred forms. Throughout the description reference is had to the accompanying drawing, in which:

Fig. 1 is a longitudinal central section showing one form of the tool in collapsed condition;

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

Figs. 3 and 4 are cross sections on lines 3-3 and 4-4 of Fig. 1; and

Fig. 5 is a fragmentary sectional view illustrating a variant form of the invention.

In the drawing, I show a tool having a tubular body 10, into the box end 10a of which is threaded the pin 11a of the tool joint 11, the latter in turn being connected to the drill string 12. On its lower end the body carries a suitable cutting tool or bit 13 which is shown to be formed integrally with the body, although the particular manner of attaching the bit to the body is in no way limitative on the invention. Cutters 14 are mounted within a transverse slot 15 in the body, the cutters consisting of blades lying alongside each other, face to face, in the body slot and movable pivotally on the transverse pivot pin 16 between the collapsed position of Fig. 1 and the expanded position shown in Fig. 2. The ends 14a and lower edges 14b of the blades, as viewed in open position, are beveled to provide sharp cutting edges, the bevels on the two blades being reversed, as illustrated, so that the bevels trail the cutting edges as the tool rotates. In fully expanded position, the cutters swing into engagement with body shoulders 17 at the upper end of slot 15, the shoulders serving as stops to limit the cutter swing and also to take the upward thrust transmitted through the cutters during operation. In their collapsed position, Fig. 1, the cutters are swung into engagement with stop pins 18, see Fig. 4, having beveled ends 18a corresponding in angularity to the bevel at the cutter edges 14b, so that the cutters are caused to bear flatly against the pins.

The cutters are actuated in their expansive movement from the position of Fig. 1 to that of Fig. 2, by fluid pressure applied to a plunger, generally indicated at 19, within bore 20 of the body. The portion 20a of the body bore within the upper interior of the body is of comparatively large diameter and tapers at 20b below shoulder 21 to a relatively small diameter bore 20c. Angular grooves 22 are formed in the body at the lower end of bore 20c to provide a downwardly flaring communication between the bore and the

cutter containing slot 15. Circulating fluid is discharged into and through the body bores by way of the tool joint bore 11b and the tubular drill string 12.

5 The cutter actuating plunger 19 comprises a head 23, preferably shaped substantially in the form of an inverted cup, as illustrated, and a rod 24 threaded at 25 into the upper end of the head and connected at 25a within a pair of links 26. 10 These links, in turn, are pivotally attached at 27 to one each of the cutters 14, the pivots 27 being offset sufficiently from the axial center of the body that downward movement of the links causes their respective cutters to swing oppositely as shown in Fig. 2. The connection at 25a 15 between the plunger rod 24 and links 26 comprises a nut 28 threaded on the lower end of the rod and having a lower bifurcated portion 28a into which is inserted a pivot pin 29 passing through the links. Nut 28 is substantially cylindrical in shape (see Fig. 3), having a substantially sliding fit within bore 20c, and is provided with vertically extending channels or recesses 30 through which circulating fluid is discharged 25 from bore 20c downwardly through grooves 22 into the slot 15.

As previously mentioned, the plunger is pressed downwardly by the circulating fluid pressure to swing the cutters from their collapsed to expanded positions. The cutters are returned to collapsed condition by a coil spring 32 encircling the plunger rod and bearing against body shoulder 21 and the lower end of plunger head 23. The plunger head 23 is designed particularly with the 35 view of avoiding any serious wear on the inner surface of the body bore wall 20a by abrasive action of the circulating fluid, and with the further object of confining substantial wear caused by the circulation fluid, to the more inexpensive and easily replaced parts of the tool. By forming the plunger head in the manner illustrated, I am able to prevent extreme high velocity flow of circulating fluid along the inner surface of the body and the severe abrasive wear on that surface that would otherwise result, by directing the 45 flow of circulating fluid passing through the plunger head, downwardly and inwardly against the rod 24, so that the relatively inexpensive and easily replaceable plunger rod takes the wear, 50 instead of the body.

The hollow plunger 23 preferably is tapered upwardly to its point of connection with the rod 24, and may be provided at its upper end with an eye 35 to receive a tool for removing a plunger 55 from the body in disassembling the tool after pin 16 has been withdrawn to disconnect the cutters. The lower portion 23b of the plunger, having a substantially sliding fit with the wall of bore 20a, carries a packing ring 36 which serves to prevent 60 leakage of the circulating fluid downwardly around the head. Provision is made for maintaining a restricted flow of circulating fluid through the plunger head by means of a plurality of circularly arranged, vertically extending slots 65 37, the lower ends of which terminate at points spaced from the wall of the body bore 20a. The plunger head is proportioned so as to have a diameter sufficiently large that the total fluid pressure acting downwardly against it will operate the cutters 14 without the necessity for particularly high fluid pressure per unit area, and also to enable the combined areas of slots 37 to be sufficiently large to avoid excessively high fluid velocities within the slots and resultant abrasive wear. Thus by giving the head a tapered or con-

ical shape, I am able to provide both the desired effective plunger area and large total slot area to the end that the necessary cutter operating pressure on the plunger may be had without excessive fluid velocities through the slots.

During operation, the circulating fluid being discharged downwardly against the plunger head is caused to flow inwardly through slots 37 in the directions indicated by the arrows, and thence downwardly and inwardly against the surface of 10 rod 24 within the plunger head. It will be observed that by virtue of its downward and inward course of flow, the circulating fluid is directed against a substantial length of the plunger rod surface. That is to say, the rod surface against 15 which the circulating fluid streams impinge is not confined to a small area, but is distributed along the length of the rod, so that any wear caused by the abrasive action of the circulating fluid is correspondingly distributed over the surface of 20 the rod and excessive wear at a localized area avoided. In order to obviate any necessity for replacing the plunger rod in case it becomes worn to a substantial degree by the circulating fluid, a replaceable sleeve 38, see Fig. 5, supported on 25 flange 39 may be placed around the upper end of the rod to receive the wear. This sleeve may be made of metal or any other suitable material such as rubber or rubber hose, and may be replaced when the tool is withdrawn from the well, in 30 case the sleeve shows wear.

After passing down through the plunger head into the space 40 between rod 24 in the body 10, the major portion of the circulating fluid is discharged outwardly into the well through passages 41 extending through the body above the cutter slot 15. The remainder of the circulating fluid passes downwardly through the channels 30 in nut 28, and through grooves 22 into the cutter slot 15, wherein the fluid constantly washes 45 the cutter blades to keep them free from accumulations of sand or mud. As will be seen from Fig. 2, the main discharge of circulating fluid through passages 41 is directed toward the extremities of the cutters in expanded positions, so that during scraping or reaming operations, the fluid constantly washes away the cuttings from the outer edges of the blades.

In the form of the invention shown in Figs. 1 and 2, it will be noted the ends 37a and 37b of the plunger slots 37 are formed by substantially vertical surfaces. If desired, as shown in Fig. 5, these end surfaces of the slots 37' may be curved inwardly as at 43 and 44 in order to increase the tendency of the circulating fluid to take an inward 55 path of flow toward the plunger rod.

#### I claim:

1. A well reaming tool comprising a tubular body, a cutter mounted within a slot in the body, a cutter operating plunger within the body and 60 connected to said cutter, said plunger having a fluid passage through which circulating fluid is discharged into a passage extending through the wall of the body above said slots and opening into the well, and means for discharging circulating fluid downwardly within the body below the 65 last mentioned passage and into said slot.

2. A well reaming tool comprising a tubular body, a cutter mounted in a slot in the body, a cutter operating plunger within the body bore and including a head and a depending rod connected to the cutter, means forming within said plunger head a fluid passage through which circulating fluid is discharged into the space between said 70 rod and the body, said body containing a circulat-

ing fluid passage leading from said space through the wall of the body above said slot and opening into the well and a passage through which circulating fluid is discharged downwardly from said space into said slot.

3. A well reaming tool comprising a tubular body, cutters mounted in the body, a cutter operating plunger including an inverted cup-shaped head having a bore, a depending rod connected to said cutters and to the upper portion of said head, said head containing a fluid passage located below the connection between said rod and the upper portion of the head and through which circulating fluid is discharged directly into a space between said rod and the body and inwardly toward the axial center of the body, and a coil spring encircling said rod and bearing against the lower end of the head outside said bore.

4. A well reaming tool comprising a tubular body, cutters mounted in the body, a body contained plunger including an inverted cup-shaped head having an inclined wall, a depending cutter actuating rod connected to the upper portion of said head and spaced from the lower portion of the head, and means forming within said inclined wall of the head, a fluid passage spaced from the wall of said body bore and through which circulating fluid is discharged into the space between said rod and the body and inwardly toward the axial center of the body, and a coil spring encircling said rod and bearing against the lower end of said head.

5. A well reaming tool comprising a tubular body, cutters mounted in the body, a body contained plunger including an upwardly tapered inverted cup-shaped head and a depending cutter actuating rod connected to the upper end of said head and spaced from the lower portion thereof, and means forming within the tapered wall of said head a fluid passage spaced from the wall of said body bore and through which circulating fluid is discharged into the space between said rod and the body.

6. A well reaming tool comprising a tubular body, cutters mounted in the body, a body contained plunger including an upwardly tapered inverted cup-shaped head and a depending cutter

actuating rod connected to the upper end of said head and spaced from the lower portion thereof, the tapered portion of said head containing a plurality of narrow vertically extending and circularly arranged slots spaced from the wall of said body and through which circulating fluid is discharged downwardly and inwardly against the surface of the top portion of said rod contained within the plunger head.

7. A well reaming tool comprising a tubular body, a cutter mounted within a transverse slot in said body, a cutter operating plunger within the body and including a rod connected to the cutter, said rod extending downwardly through a body bore directly above said slot, and means for conducting circulating fluid through an open space between the plunger rod and the wall of said bore, straight downwardly around the rod into the top of said body slot.

8. A well reaming tool comprising a tubular body, a cutter mounted within a transverse slot in said body, a cutter operating plunger within the body and including a rod extending downwardly within and spaced from the wall of a body bore located directly above said slot, means connecting the rod with said cutter, and a member carried on said rod and slidably engaging the wall of said bore, said member containing an opening through which circulating fluid is discharged downwardly through said bore into the upper end of said body slot.

9. A well reaming tool comprising a tubular body, cutters mounted within a transverse slot in said body, a cutter operating plunger within the body and including a rod extending downwardly within and spaced a substantial distance from the wall of a body bore located directly above said slot to provide a fluid passage, and means connecting said rod with the cutters, the last mentioned means including a member carried on the lower end of the rod within said bore and having a pair of openings through which circulating fluid is discharged straight downwardly through said bore into the upper end of said body slot.

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