

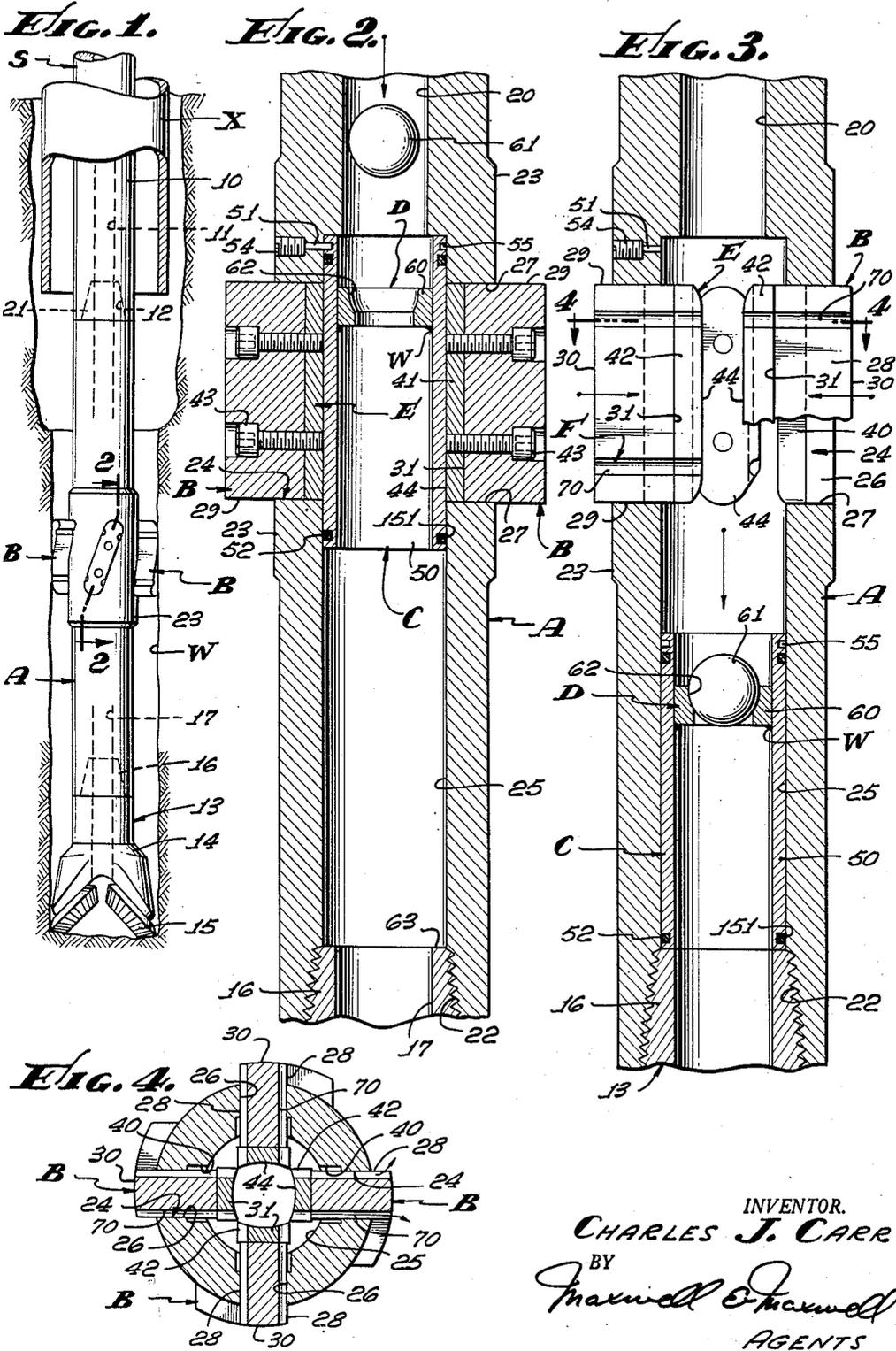
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REAMER

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AGENTS

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REAMER

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This invention has to do with a reamer for use in a well, and is more particularly concerned with a reamer having retractable cutters.

In many instances, while drilling a well, the drilling bit becomes worn to a degree that the well bore produced thereby is under-gauged. It also frequently happens that the bore of the well, due to the rock formation and/or the speed at which the well is being drilled, will be uneven and rough and to the extent that withdrawal of the drilling string and/or lowering of a well casing therein is impeded.

As a result of the above, it is common practice to provide one or more reaming tools in the drilling string, which tools serve to smooth the well bore and to ream and bring it out to gauge.

Heretofore, reaming tools of the class herein referred to have been in the nature of subs engaged at the ends of the drill collar, or at any other desired point along the drilling string, and are provided with rigid, radially outwardly projecting, circumferentially spaced cutters. It has been found that when the drilling string is being withdrawn from the well, the cutters of the ordinary or conventional reamers drag along and scar or cave in the well bore and also frequently catch and become hung up in the well bore or on the lower terminal end of the well casing that has been lowered into the well. It also frequently happens that the cuttings made by the reamer and the drilling bit, pack between the cutters, rendering the cutters ineffective, cutting off circulation of fluid in the well and freezing or packing the drill string in the well.

It is an object of the present invention to provide a reaming tool of the general character referred to, having a plurality of circumferentially spaced radially outwardly projecting cutters, which cutters can be retracted when the reamer becomes packed or hung up in the well, or when the drilling string is being pulled from the well.

Another object of the present invention is to provide a reamer of the character referred to wherein the cutter blades are normally maintained in operating position by a longitudinally shiftable member, which member is adapted to be operated or shifted out of engagement with the cutters by interrupting the flow of circulating fluid through the reamer.

Still another object of the present invention is to provide a reamer of the general character referred to having cutters that can be easily and quickly repaired and/or replaced.

It is an object of this invention to provide a reamer having few parts and a reamer which is both easy and economical of manufacture and which is both effective and dependable in operation.

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 my invention, throughout which description reference is made to the accompanying drawings, in which:

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Fig. 1 is a view illustrating a reamer embodying the present invention and carried by a drilling string and located in a well bore. Fig. 2 is an enlarged longitudinal detailed sectional view of the reamer that we provide, it being a view taken substantially as indicated by line 2-2 on Fig. 1. Fig. 3 is a view similar to Fig. 2 but showing the device in an actuated position and the cutters therein being shown in elevation. A portion of one of the cutters illustrated in Fig. 3 is broken away to better illustrate the body construction of our reamer. Fig. 4 is a transverse sectional view taken as indicated by line 4-4 on Fig. 3.

In Fig. 1 of the drawings, I have illustrated my new reamer construction engaged in a drilling string S, extending into a well bore W. The string S is shown as extending through a suitable casing X in the well to extend beyond the lower terminal end thereof.

The drilling string S is shown as including an elongate drill collar 10 and a typical roller bit 13. The drill collar 10 is shown as having a central flow passage 11 extending longitudinally therethrough and as having a threaded socket 12 entering it from its lower end. The roller bit 13 is related to the lower end of the drill collar 10 and includes a vertically disposed body 14, cutters 15 rotatably carried by the body at the lower end thereof, a threaded pin 16 projecting upwardly from the upper end of the body and adapted to be engaged in the socket 12 in the drill collar 10, and a central longitudinal flow passage 17 extending through the body and the pin and adapted to conduct fluid handled by the drilling string, through the drill bit and into the well bore.

The reamer provided by the present invention is shown engaged in the string S to occur between the drill collar 10 and the bit 13. The reamer is shown as including, a body A, a plurality of cutters B shiftable carried by the body to normally project radially outwardly therefrom and to engage the well bore, stop means E on the cutters and engageable with the body to prevent excessive outward movement and displacement of the cutters in the body, retaining means C carried by the body to normally engage the stop means E on the cutters and to hold the cutters out and in engagement with the well bore, actuating means D related to the retaining means and adapted to shift the retaining means out of engagement with the cutters to allow the cutters to shift in the body, and drain means F adapted to allow fluid within the drill string to drain into the well bore after the means C has been actuated and the drilling string is being pulled from the well.

The body A that I provide is an elongate vertically disposed tubular member having a central longitudinal flow passage 20 extending therethrough. In practice, the reamer body is in the nature of a sub engageable in the drill string S to occur between the drill collar and the bit 13, and is provided with a threaded pin extension 21 at its upper terminal end adapted to be engaged in the socket 12 in the lower end of the drill collar 10, and a threaded socket 22 entering it from its lower terminal end and adapted to receive the threaded pin 16 of the rotary bit 13.

In the particular case illustrated, the body A is shown as provided with a slightly enlarged central portion 23. The central portion is shown provided with a plurality of circumferentially spaced elongate slot-like openings 24 adapted to slidably receive and support the cutters B. The body A is shown as further including an enlarged central longitudinally disposed bore 25 open at the lower end of the body and terminating above the said central portion 23 of the body and adapted to accommodate the retaining means C for the cutters.

The slot-like openings 24 in the body A and adapted to receive the cutters B, extend through the wall of the

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body to establish open communication between the exterior of the body and the bore therein and have straight flat parallel side walls 26 and rounded end walls 27. In the preferred carrying out of the invention, the openings 24 are pitched or inclined relative to the longitudinal axis of the body and so that the cutters carried thereby, are pitched or inclined as clearly illustrated in Fig. 1 of the drawings.

In Figs. 2 and 3 of the drawings, the cutters B are shown extending parallel with the body A for the purpose of better illustrating the construction of the device.

The cutters B that I provide are simple, straight bar-like parts with straight flat parallel sides 28 and rounded ends 29, which sides and ends are adapted to establish sliding engagement with the side and end walls 26 and 27 of the openings 24 in the body. The cutters B are further provided with curved outer faces 30 adapted to establish flat engagement with the well bore W when the reamer is in operation, and straight flat inner faces 31 adapted to occur within the body and to engage and carry the stop means E.

The stop means E that I provide is adapted to limit outward movement of the cutters B in the body A, and is shown as including a straight elongate recess 40 in the body A and along or adjacent each side wall 26 of the openings 24 therein, and communicating with the bore, as clearly illustrated in Figs. 3 and 4 of the drawings, and stop plates 41 fixed to the flat, inner faces of the cutters and having flange-like edge portions 42 that project laterally from the sides of the cutter and engage and seat in the recesses 40. In the case illustrated the stop plates 41 are shown secured to the cutters B by means of suitable screw fasteners 43, and in the manner illustrated, clearly in Fig. 2 of the drawings.

The inner sides 44 of the stop plates, facing the bore of the body A, are curved so that when the plates are seated in the recesses 40, the inner sides 44 of the plates are concentric and flush with the bore 25 of the body.

In practice, each cutter and its related stop plate could be integrally joined together by welding or could be cast, machined, forged or otherwise formed as an integral unit.

The retaining means C provided by the present invention and adapted to normally hold the cutters B out, and in engagement with the well bore W, is shown as including, an elongate tubular sleeve 50 slidably engaged in the bore 25 of the body, a shear pin 51 carried by the body and engaged in the sleeve to normally prevent shifting of the sleeve in the body.

The sleeve 50 is a simple straight tubular member of substantially greater longitudinal extent than the openings 24 in the body A and the stop plates 41 on the cutters B, so that when it is positioned in the upper portion of the bore 25 in the body, as illustrated in Fig. 2 of the drawings, it overlies the stop plates 41 and holds them in seated engagement in the recesses 40 in the body and prevents inward movement of the cutters in the body.

The upper and lower end portions of the sleeve 50 extend beyond the ends of the stop plates on the cutters B and are provided with annular grooves 15 about their outer periphery and in which suitable sealing rings 52 are engaged, to seal with the bore in the body and to normally prevent flow of circulating fluid from within the reamer body past the cutters and into the well bore.

The shear pin 51 holding the sleeve 50 in the upper portion of the bore in the body is carried by the body by means of a suitable threaded carrier 54 engaged in the body from the exterior thereof, and engages in a suitable annular groove 55 in the sleeve above the seal carrying groove 52 in the upper end portion of the sleeve.

The actuating means D related to the retaining means C and adapted to shift the retaining means out of engagement with the backing plates 41 and thereby permit the cutters B to shift into the body, includes, an annular seat ring 60 in the sleeve 50 and a spherical valve member or ball 61 adapted to be introduced into the drill

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string at the upper or top end of the well, and adapted to fall or be carried by the drilling fluid into sealing engagement with the ring 60. The ring 60 is a simple annular ring-like part fixed in the sleeve 50 as by welding W or the like, and has an upwardly facing spherically curved seat 62 adapted to accommodate and seal with the ball 61. The ball 61 is a simple steel ball.

With the structure set forth above, it will be apparent that when the ball 61 is placed in the drill string and seats on the ring 60, the flow of fluid through the drilling string is shut off, and that upon the application of sufficient fluid pressure upon the column of fluid in the string, above the ball, as by suitable pumping means at the top of the well, the pin 51 can be sheared and the sleeve 50 urged downwardly in the bore of the body where it is out of engagement with the backing plates 41. In the particular case illustrated, excessive downward movement of the sleeve 50 in the bore of the body A is prevented by the upper terminal end of the pin 16 of the bit 13, which pin is engaged in the socket opening 22 in the bottom end of the body A and serves to establish an upwardly facing stop shoulder 63 at the lower end of the bore 25.

After the sleeve 50 has been actuated or shifted in the manner set forth above, and the pressure exerted upon the column of fluid in the string S is released, the cutters B are free to shift radially inwardly into the body, as clearly illustrated in Fig. 3 of the drawings. In practice, engagement of the cutters on the well bore, well tubing or any other obstruction that might occur in the well, is sufficient to shift the cutters radially inwardly into the body in the manner desired. However, if it is desired to retract all of the cutters as far as possible, reversed flow of fluid in the well string can be temporarily established, which flow of fluid will draw the cutters inwardly as desired.

In order to pull or draw the drilling string S from the well, I have provided a suitable drain means F in each cutter B adapted to permit the fluid in the drill string to flow between the cutters B and the body A and into the well bore W. The drain means F is shown as including one or more fluid handling grooves 70 in the sides 28 of the cutters and extending between the inner and outer faces 30 and 31 thereof. In the preferred carrying out of the invention, the grooves 70 continue inwardly through the flange portions 42 of the backing plates 41 and establish open communication with the interior of the body, when the retaining sleeve is in the down or actuated position.

With the above relationship of parts, it will be apparent that after the sleeve 50 has been actuated and shifted into the lower portion of the bore in the body, fluid within the string is free to flow out through the grooves 70 in the cutters B and into the well bore.

It is to be understood that, in practice, the reamer that I provide could, if desired, be placed at any point along the drilling string S and that the particular arrangement shown and described above is only typical or illustrative of one arrangement and relationship of parts.

Throughout the drawings, I have shown my reamer as having four cutters. It is to be understood, however, that, in practice, the number of cutters provided can vary widely as circumstances require.

Having described only a typical preferred form and application of my 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 claims.

Having described my invention, I claim:

1. A reamer of the character referred to including, an elongate tubular body engageable in a fluid handling drilling string, a plurality of cutters shiftably carried by the body to project radially outwardly therefrom, an elongate fluid conducting sleeve slidably engaged in the body

and positioned radially inward of and adjacent to the cutters to prevent them from shifting radially inwardly, and fluid pressure actuated control means adapted to shift the sleeve longitudinally of the body and away from the cutters.

2. A reamer of the character referred to including, an elongate body with a central longitudinal flow passage and engageable in a fluid handling drilling string, a plurality of circumferentially spaced openings in the body, a plurality of cutters shiftably carried in the openings to project radially outwardly from the body, an elongate fluid conducting sleeve slidably engaged in the body concentric with the flow passage and positioned to occur radially inward of and adjacent to the cutters to prevent inward shifting of the cutters in the body, and fluid pressure actuated control means related to the sleeve and adapted to shift the sleeve longitudinally of the body and away from the cutters.

3. A reamer of the character referred to including, an elongate vertically disposed body with a central longitudinal flow passage extending therethrough and engageable in a fluid handling drilling string, a bore in the body concentric with and larger in diameter than the flow passage, a plurality of lateral openings in the body and communicating with the bore therein, a cutter slidably engaged in each opening in the body to project radially outwardly therefrom, a fluid conducting sleeve slidably engaged in the bore and concentric with the flow passage and position to overlie the openings and hold the cutters out, and fluid pressure actuated control means adapted to shift the sleeve downwardly in the bore and away from the openings.

4. A reamer of the character referred to including, an elongate vertically disposed body with a central longitudinal flow passage extending therethrough, a threaded pin projecting from one end of the body and a threaded socket entering the other end of the body and adapted to connect with parts of a fluid handling drill string, a bore in the body concentric with and larger in diameter than the flow passage, a plurality of lateral openings in the body and communicating with the bore therein, a cutter slidably engaged in each opening in the body to project radially outwardly therefrom and having an outer face adapted to engage a well bore, a fluid conducting sleeve slidably engaged in the bore and concentric with the flow passage and positioned to overlie the openings and hold the cutters out, and fluid pressure actuated control means adapted to shift the sleeve downwardly in the bore and away from the opening and including a seat ring in the sleeve and a valve member adapted to be dropped into engagement on the ring.

5. A reamer of the character referred to including, an elongate vertically disposed body with a central longitudinal flow passage extending therethrough and engageable in a fluid handling drilling string, a plurality of slot-like openings in the side of the body and communicating with the passage, an elongate cutter slidably engaged in each opening in the body to project radially outwardly therefrom, a central longitudinally disposed fluid conducting sleeve slidably engaged in the passage in the body to overlie the openings therein and limit inward movement of the cutters, and fluid pressure actuated control means adapted to shift the sleeve downwardly in the body and away from the openings therein.

6. A reamer of the character referred to including, an elongate vertically disposed body with a central longitudinal flow passage extending therethrough, a threaded pin projecting from one end of the body and a threaded socket entering the other end of the body and adapted to connect with parts of a fluid handling drill string, a plurality of slot-like openings in the side of the body and

communicating with the passage, an elongate cutter slidably engaged in each opening in the body, to project radially outwardly therefrom, an elongate central longitudinally disposed fluid conducting sleeve slidably engaged in the passage in the body to overlie the openings therein and limit inward movement of the cutters, fluid pressure actuated control means adapted to shift the sleeve downwardly in the body and away from the openings therein, the said opening and cutters being pitched relative to the longitudinal axis of the body and drain means adapted to establish open communication between the interior and exterior of the body when the sleeve is shifted.

7. A reamer of the character referred to including, an elongate vertically disposed body engageable in a drilling string and having a central longitudinal flow passage and engageable in a fluid handling drilling string, a plurality of elongate slot-like openings in the body and communicating with the passage therein, an elongate cutter slidably engaged in each opening to project radially outwardly therefrom, a central longitudinally disposed fluid conducting sleeve slidably engaged in the passage, a shear pin carried by the body and engaging the sleeve to hold the sleeve up where it overlies the openings in the body and holds the cutters, fluid pressure actuated control means adapted to shut off flow through the sleeve and cause the pin to shear and the sleeve to shift downwardly in the body and away from the openings and the cutters including, an annular seat ring in the sleeve, and a ball engageable in the drilling string and adapted to drop onto or seat on the ring and drain means adapted to establish open communication between the interior and exterior of the body when the sleeve is shifted, said drain means including a radially disposed fluid conducting groove in one of the cutters.

8. A reamer of the character referred to including, an elongate vertically disposed body engageable in a drilling string and having a central longitudinal flow passage extending therethrough and engageable in a fluid handling drilling string, a plurality of elongate slot-like openings in the body and communicating with the passage therein, elongate radially inwardly opening recesses in the body along the sides of the openings, an elongate cutter with inner and outer faces slidably engaged in each opening to project radially outwardly therefrom, stop plates on the inner faces of the cutter and adapted to normally engage and seat in the recesses, a central longitudinally disposed fluid conducting sleeve slidably engaged in the passage and positioned to overlie the openings and engage the stop plates, a shear pin carried by the body and engaging the sleeve to hold the sleeve up where it overlies the openings in the body, fluid pressure actuated control means adapted to shut off flow through the sleeve and cause the pin to shear and the sleeve to shift downwardly in the body and away from the openings and the plate on the cutters including an annular seat ring in the sleeve, and a ball engageable in the drilling string and adapted to drop onto or seat on the ring and drain means adapted to establish open communication between the interior and exterior of the body when the sleeve is shifted and including a plurality of radially disposed fluid passages in the cutters.

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