Aug. 10, 1965 A. W. KAMMERER, JR 3,199,599

SCRAPERS FOR TUBULAR STRINGS

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FIG. 1.

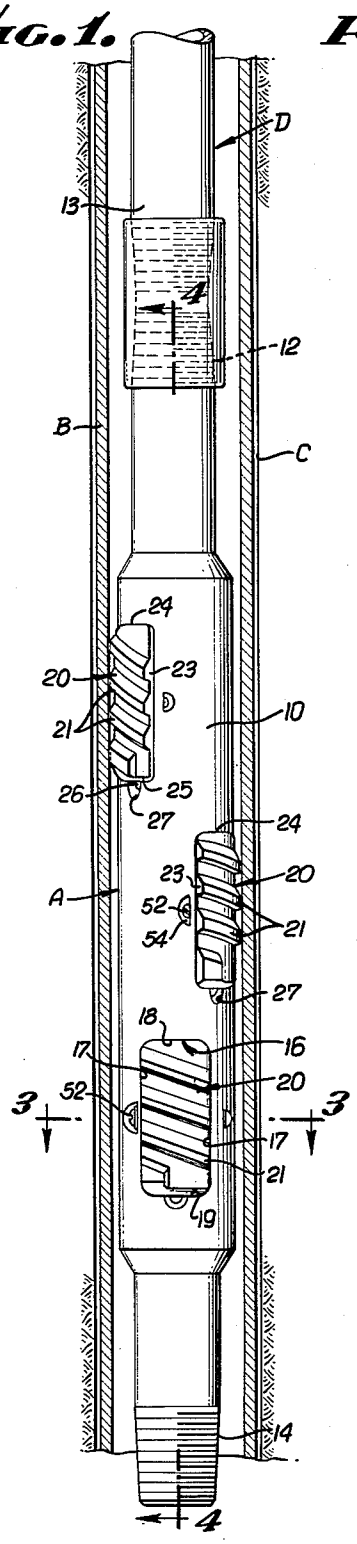


FIG. 2.

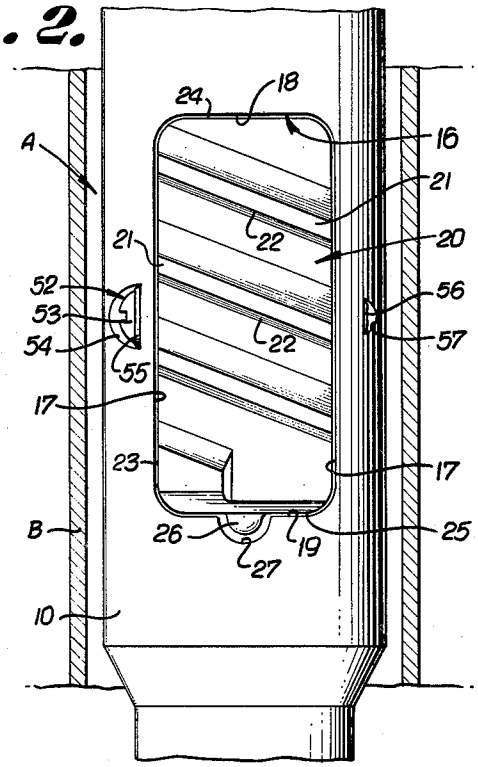
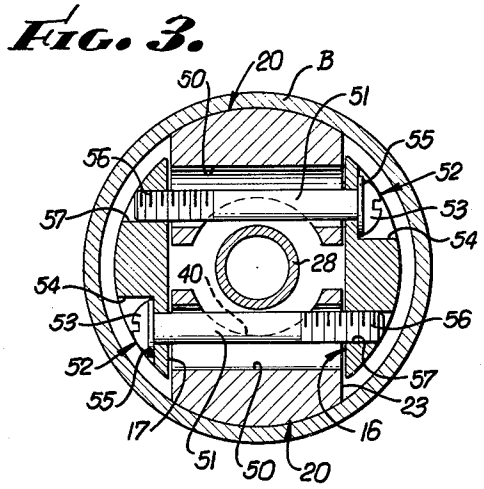


FIG. 3.



INVENTOR.
ARCHER W. KAMMERER, JR.
BY
Mellin and Hanscom
ATTORNEYS.

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FIG. 4.

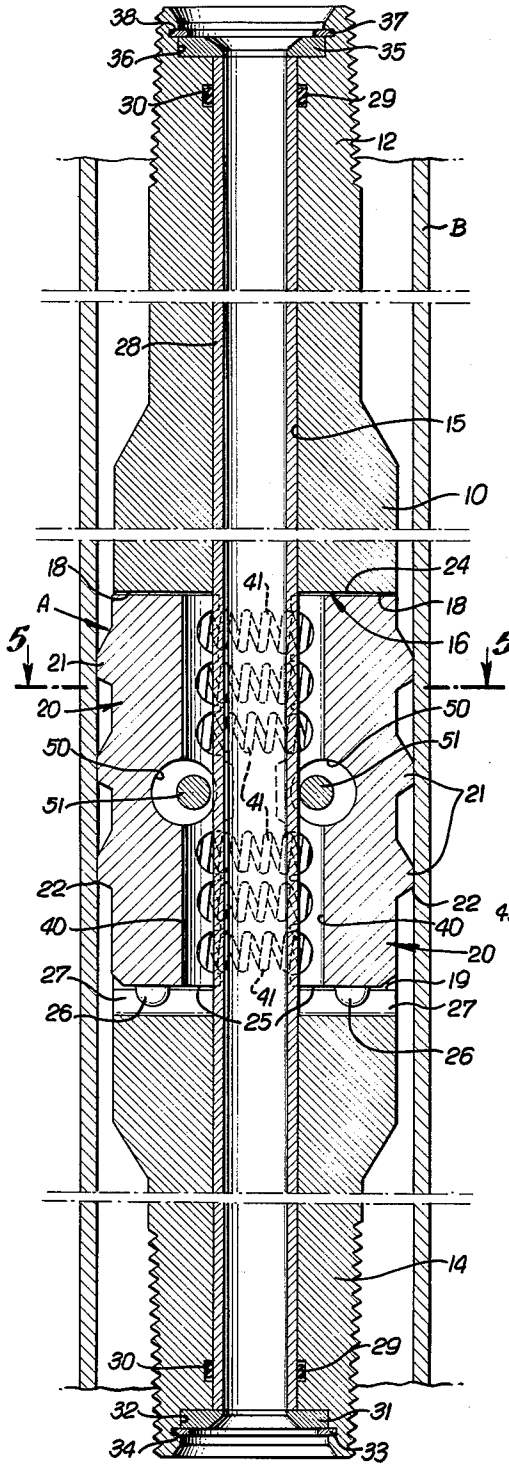


FIG. 5.

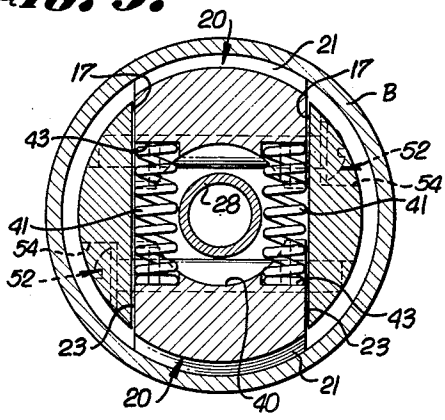


FIG. 6.

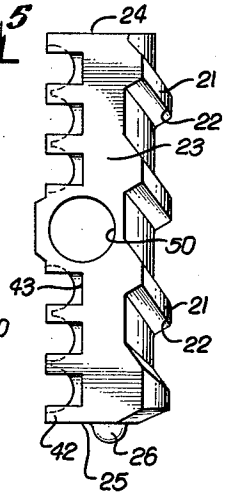


FIG. 7.

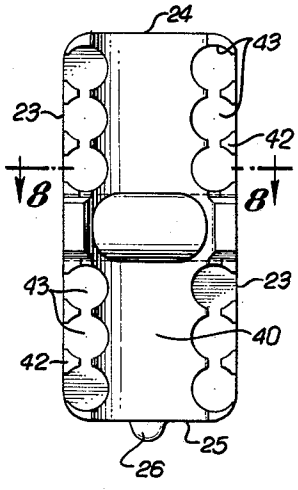
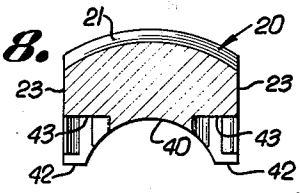


FIG. 8.



INVENTOR.

ARCHER W. KAMMERER, JR.

BY

Mellin and Hanscom

ATTORNEYS.

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3,199,599

SCRAPERS FOR TUBULAR STRINGS

Archer W. Kammerer, Jr., Houston, Tex., assignor to Bakers Oil Tools, Inc., Los Angeles, Calif., a corporation of California

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16 Claims. (Cl. 166—173)

The present invention relates to subsurface well bore equipment, and more particularly to scrapers for removing substances from the inner walls of tubular strings disposed in well bores, such as coatings of drilling mud, cement, rust, mill scale, paraffin, and embedded bullets, and burrs formed by bullets fired through the tubular strings.

An object of the present invention is to provide a scraper for use in tubular strings, which is of strong and sturdy construction, economical to manufacture, possessed of relatively few parts, and relatively easy to assemble and disassemble.

Another object of the invention is to provide a scraper for use in tubular strings of relatively small diameters, such as in tubing disposed in a well bore, the scraper having considerable strength despite its small size, and well able to withstand safely extreme loads to which it might be subjected.

A further object of the invention is to provide a scraper for use in a tubular string which has laterally shiftable cutter members that can collectively cover the 360 degree circumference of the inner wall of the tubular string, allowing the scraper to clean the entire circumference of the tubular string as a result of moving the scraper longitudinally therethrough, and which is also effective in cleaning the inner wall of the tubular string upon rotation of the scraper, there being large bearing areas for transmitting torque and longitudinal thrusts from the main body of the scraper tool to the cutter members mounted thereon. Such large bearing areas are present and the body of the tool has great strength despite the making of the tool of small size for operating in relatively small diameter tubular strings, such as tubing strings.

An additional object of the invention is to provide a scraper for cleaning the inner wall of a tubular string disposed in a well bore and through which circulating fluid can be pumped, in which such fluid is prevented from eroding or fluid cutting the main body of the scraper.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

FIGURE 1 is a side elevational view of a scraper disposed in a tubular string;

FIG. 2 is an enlarged side elevational view of a portion of the scraper illustrated in FIG. 1;

FIG. 3 is an enlarged cross-section taken along the line 3—3 on FIG. 1;

FIG. 4 is an enlarged longitudinal section taken along the line 4—4 on FIG. 1;

FIG. 5 is a cross-section taken along the line 5—5 on FIG. 4, but rotated 90 degrees relative to the position illustrated in FIG. 4;

FIG. 6 is a side elevation of one of the scraper blades;

FIG. 7 is a rear elevation of one of the scraper blades, as seen from the left of FIG. 6;

FIG. 8 is a cross-section taken along the line 8—8 on FIG. 7.

The scraper A illustrated in the drawings is designed to clean the inner wall of a tubular string B, such as a string of tubing, disposed in a well bore C. The scraper includes a generally cylindrical, elongate body 10 having an upper threaded pin 12 for securing the body of the lower end 13 of a running-in string D, such as a tubular string, which lower end may be constituted as a coupling. The lower end of the body 10 may be constituted as a threaded pin 14 thereon for attachment to a lower tubing section (not shown), which may, in turn, be secured to a rotary drill bit (not shown).

The cylindrical body of the tool has a central passage 15 extending completely therethrough, as well as longitudinally spaced lateral slots 16 which are angularly displaced or out of phase with one another circumferentially of the body of the tool. Each slot 16 extends from the periphery of the body at one side thereof through the diametrically opposite side, and also intersects the passage 15 through the tool. Each slot has parallel side walls 17 and parallel top and bottom walls 18, 19 normal thereto, there being diametrically opposite scraper blades or cutters 20 mounted in each slot and having external scraper teeth 21 for operation upon the inner wall of the tubular string B. These teeth 21 are curved to conform substantially to the inner wall of the tubular string when engaged therewith. The teeth 21 on the exterior of each scraper blade 20 are longitudinally spaced from each other and are inclined or helical, the lower edge 22 of each tooth being suitably hardfaced so as to enhance its wear resistance.

Each blade has parallel side walls 23 slidable along the side walls 17 of the slot and also top and bottom walls 24, 25 slidable along the top and bottom walls 18, 19 that define each slot. To prevent each blade 20 from being mounted in its slot 16 in an inverted position, the lower end of each blade may be formed with a relatively small downward projection 26 slidably fitting within a central radial groove 27 opening into the bottom 19 of the slot.

The width of each slot 16 is substantially greater than the diameter of the central passage 15 through the body 10 of the tool. To allow drilling fluid to be pumped down through the device for continued flow to a lower tool, such as a drill bit (not shown), a central tubular member or wash pipe 28 is inserted in the central passage 15, extending substantially from its top to its bottom ends. Leakage of fluid between the wash pipe and the wall of the body passage 15 is prevented by suitable upper and lower seals rings 29, such as rubber or rubber-like O rings, disposed in internal grooves 30 in the tool body 10 and engaging the periphery of the wash pipe 28. The lower end of the wash pipe or tubular member engages a spacer ring 31 disposed in a counterbore 32 in the lower pin end 14 of the body, the spacer ring being held in place by a split, snap retainer ring 33 overlying the lower end of the spacer ring and disposed within an internal groove 34 in the body. Similarly, a spacer ring 35 overlies the upper end of the tubular member 28, being disposed in a counterbore 36 in its upper portion and held in place by a split, snap retainer ring 37 disposed within an internal groove 38 in the upper portion 12 of the body and overlying the spacer ring 35. By removing one or both of the retainer rings 33, 37, as a result of retracting them inwardly from their respective grooves 34, 38, a spacer ring 31 or 35 can be removed and the tubular member or wash pipe 28 taken from the central passage 15 of the body 10.

The tubular member or circulation tube 28 is easily mounted in the body 10 of the tool. Since it is a part separate from the tool body 10, it can be made of a

harder material and more resistant to fluid cutting or the erosive action of the drilling mud, or other fluid, being pumped down through the tubular string D or drill pipe, or the like, and through the tube 28. Thus, the circulating fluid does not act on the interior of the tool body 10 at all, resulting in the body having a much longer life. In the event that substantial wear does occur on the circulation tube 28, it is easily replaced without the necessity for replacing the entire body 10.

For the purpose of increasing the bearing area between the sides 23 of each blade 20 and the companion adjacent sides 17 of each slot 16, the inner portion 40 of each blade is made concaved or recessed along its entire longitudinal extent, so as to allow the blade to extend inwardly of the slot 16 and around the wash pipe 28, the latter being received within the longitudinal blade recess 40, as disclosed in the drawings. Thus, there is a greater side area on each blade 20 engaging the companion side 17 of the body slot for the transmission of torque during rotation of the tool in effecting the scraping of the inner wall of the tubular string B.

The diametrically opposed blades 20 each constitute a set, and each set of blades is urged in opposite directions outwardly of the body 10 by a spring device. As disclosed, a row of longitudinally spaced helical springs 41 is provided on each side of the wash pipe 28, engaging inwardly directed flanges 42 of the opposed scraper blades 20, each spring extending between and engaging the flanges 42 of the opposed blades and urging the blades outwardly. To insure the retention of the springs 41 in appropriate assembled position, their end portions are disposed in spring sockets 43 formed in the side portions or blade flanges 42, the springs bearing against the base or inner ends of the sockets. The force provided by the sets of longitudinally spaced laterally extending springs 41 on opposite sides of the wash pipe 28 against the blades 20 can be quite substantial, pressing the blade teeth 21 against the wall of the tubing B.

The blades can shift inwardly of its slot 16 against the force exerted by the springs 41. The extent of shifting of each blade outwardly of the body is limited by a suitable stop device. As shown, there is an enlarged transverse opening 50 extending through each blade through which a stop element, such as the shank 51 of a stop screw 52, extends, this shank having a much smaller diameter than the diameter of the opening 50. The head 53 of the stop screw is disposed in a suitable external body recess 54 so as to lie within the periphery of the body 10, this head bearing against a suitable lock washer 55 engaging the base of the recess 54. The opposite end 56 of the screw is threaded and is threadedly received within a companion threaded bore 57 in the body 10 of the tool. By suitable tightening of the screw 52, it will remain attached to the tool body 10, extending through the enlarged opening 50. When the tool A is out of the tubular string B, the spring 41 can only expand the cutter blades 20 outwardly of the periphery of the body to the extent determined by engagement of the inner portions of each blade, which, as shown, are the flange portions 42, with the stop screw 52.

As illustrated in the drawings by way of example, the tool A has three sets of scraper blades 20 disposed in three slots 16 extending completely through the body 10 of the tool and intersecting its central passage 15. The body slots 16 receiving the sets of cutter blades are disposed progressively out of phase with one another, so that the cuttter blades 20 disposed in the slots and their teeth 21 collectively cover the entire circumference of the inner wall of the tubular string B in which the tool is disposed. With the three sets of blades specifically shown in the drawings, the progressive displacement of each set of blades, from the upper to the lower set, about 60 degress from one another, with the cutter teeth 21 on each blade covering about 60 degrees of arc, will result in all of the cuttters 20 collectively covering the entire circumference of the inner wall of the tubular string B in which the scraper is being operated.

The scraper can be attached to a string of drill pipe D, or the like, and lowered in the well tubing B. The mere movement of the scraper longitudinally through the tubing, without rotation, will cause its inclined helical teeth 21 to scrape the entire circumference of the tubular string B. If desired, the drill pipe D and tool A can be rotated, and because of the inclination of the teeth 21, the wall of the tubular string will also be scraped to remove foreign substances therefrom, effecting its thorough cleaning. During the longitudinal movement, or rotation, or both, of the tubular body 10 of the tool and of the scraper blades 20, the springs 41 are urging the teeth 21 against the foreign substances and the wall of the tubular string with substantial force, which force depends upon the strength of the helical compression springs. A large bearing area exists between the upper ends 13 of the slots 16 and the upper ends 24 of the cutter blades in forcing the scraper tool A downwardly through the well casing, and a large bearing area is also present between the trailing sides 17 of each slot and the trailing sides 23 of each blade for the transmission of substantial torque in scraping the inner wall of the tubular string, as a result of rotating the apparatus. Such large areas and their substantial inward extent insure the proper guiding of the scraper blades 20 in the body slots 16 and prevents their cocking or binding therewithin. They also insure a long and useful life of the body 10 of the tool and of the scraper blades 20 themselves. Despite the use of comparatively wide slots 16 through the tool body, its minimum cross-sectional area is still very large, resulting in the body possessing great strength, capable of safely withstanding extremely heavy torques and longitudinal forces to which it might be subjected. Such large cross-sectional area is maintained despite the making of the scraper body of a comparatively small diameter to enable effective use of the apparatus A in tubing strings B of comparatively small diameter. The scraper apparatus is easily assembled and dismantled and has relatively few parts. Its manufacture is comparatively simple and economical, since the slots 16 through the body are readily formed and the scraper blades 20 themselves are easily made through simple casting procedures, requiring essentially no finishing, other than the application of hardfacing to the scraper teeth 21.

Although the scraper has been described in connection with running it in the tubular string B on drill pipe D, or the like, it may, if desired, be used on a wire line or cable. As an example, the cable may be attached to suitable sinker bars and jars (not shown) which are connected to the upper end 12 of the body 10 of the tool, the sinker bars and jars providing sufficient weight for forcing the scarping tool A downwardly through the casing. Such longitudinal movement in a downward direction will scrape the entire circumference of the wall of the tubular string B, in view of the fact that the scraper teeth 21 collectively cover a full 360 degree extent of the tubular string wall.

I claim:

1. In a tubular string scraper: a main body having means for attachment to a running-in string and having a central longitudinal passage therethrough; said body having opposed lateral slots extending inwardly from its periphery and opening directly into said passage throughout substantially the entire length of said slots; a tubular member in said passage extending across said slots for conducting drilling fluid through said body; opposed cutters slidable laterally in said slots, each cutter having inner portions extending partially around and astride said tubular member, said inner portions being slidable along the sides of said slots; and means normally urging said cutters laterally outwardly.

2. In a tubular string scraper: a main body having means for attachment to a running-in string and having

a central longitudinal passage therethrough; said body having opposed lateral slots extending inwardly from its periphery and opening directly into said passage throughout substantially the entire length of said slots; a tubular member in said passage extending across said slots for conducting drilling fluid through said body; opposed cutters slidable laterally in said slots and having inner portions extending partially around said tubular member and slidable along the sides of said slots; and yieldable means extending transversely of said tubular member and on opposite sides thereof and disposed between and engaging said cutters for urging said cutters laterally outwardly.

3. In a tubular string scraper: body means adapted for attachment to a running-in string and having a longitudinal passage therethrough; said body means having opposed lateral slots extending inwardly from its periphery and directly opening into said passage; oppose cutters slidable laterally in said slots and having inner portions confronting each other, said cutters having scraping teeth disposed at least partially longitudinally of said body means to scrape the tubular string upon rotation of said body means; and yieldable means common to said cutters and located between and engaging said confronting inner portions of said cutters for urging said cutters laterally outwardly.

4. In a tubular string scraper: body means adapted for attachment to a running-in string and having a longitudinal passage therethrough; said body means having opposed lateral slots extending inwardly from its periphery and opening into said passage; opposed cutters slidable laterally in said slots, each cutter having external scraping teeth extending at least partially longitudinally of said cutter to engage the wall of the tubular string along an extended length to scrape the same upon rotation of said body means; and a plurality of springs between said cutters, each spring engaging said opposed cutters to urge said cutters in opposite directions laterally outwardly.

5. In a tubular string scraper: a main body adapted for attachment to a running-in string and having a longitudinal passage therethrough; said body having opposed lateral slots extending inwardly from its periphery and opening into said passage; a tubular member in said passage extending across said slots for conducting drilling fluid through said body; opposed cutters slidable laterally in said slots and having inner portions extending partially around said tubular member; and a plurality of springs between said cutters, each spring engaging said opposed cutters to urge said cutters in opposite directions laterally outwardly.

6. In a tubular string scraper: a main body having means for attachment to a running-in string and having a central longitudinal passage therethrough; said body having opposed lateral slots extending inwardly from its periphery and opening into said passage; a tubular member in said passage extending across said slots for conducting drilling fluid through said body; cutters slidable laterally in said slots and having concave inner portions extending partially around said tubular member and providing opposed inner side flanges on each of said cutters on opposite sides of an astride said tubular member, said flanges being slidable along the sides of said slots; and yieldable means common to said cutters and located between and engaging said side flanges to urge said cutters laterally outwardly.

7. In a tubular string scraper: a main body adapted for attachment to a running-in string and having a longitudinal passage therethrough; said body having opposed lateral slots extending inwardly from its periphery and opening into said passage; a tubular member in said passage extending across said slots for conducting drilling fluid through said body; cutters slidable laterally in said slots and having concave inner portions extending partially around said tubular member and providing opposed inner side flanges on said cutters on opposite sides of said tubular member; and a plurality of springs between said opposed side flanges on opposite sides of said tubular member, each spring engaging said opposed side flanges to urge said cutters in opposite directions laterally outwardly.

8. In a tubular string scraper: a main body having means for attachment to a running-in string and having a longitudinal passage therethrough; said body having opposed lateral slots extending inwardly from its periphery and opening directly into said passage, each slot being defined by top, bottom and side body walls, said passage opening into said opposed slots at said top and bottom walls of each slot; a tubular member in said passage extending across said slots for conducting drilling fluid through said body; cutters slidable laterally in said slots, each cutter being engageable with all walls of its slot to prevent longitudinal and transverse movement of said cutter with respect to said body and being guided in its lateral movement by all walls of its slot, said cutters having scraping teeth disposed at least partially longitudinally of said body to scrape the tubular string upon rotation of said body; and means normally urging said cutters laterally outwardly.

9. In a tubular string scraper: a main body adapted for attachment to a running-in string and having a longitudinal passage therethrough; said body having opposed lateral slots extending inwardly from its periphery and opening directly into said passage, each slot being defined by top, bottom and side body walls; a tubular member in said passage extending across said slots for conducting drilling fluid through said body; opposed cutters slidable laterally in said slots, each cutter being engageable with all walls of its slot to prevent longitudinal and transverse movement of said cutter with respect to said body and being guided in its lateral movement by all walls of its slot; and a plurality of springs between said cutters, each spring engaging said opposed cutters to urge said opposed cutters in opposite directions laterally outwardly.

10. In a tubular string scraper: body means adapted for attachment to a running-in string and having a longitudinal passage therethrough; said body means having opposed lateral slots extending inwardly from its periphery and opening directly into said passage, each slot being defined by top, bottom and side body walls, said passage opening into said opposed slots at said top and bottom walls of each slot; opposed cutters slidable laterally in said slots and having inner portions confronting each other, each cutter being engageable with all walls of its slot to prevent longitudinal transverse movement of said cutter with respect to said body means and being guided in its lateral movement by all walls of its slot, said cutters having scraping teeth disposed at least partially longitudinally of said body to scrape the tubular string upon rotation of said body; and yieldable means common to said cutters and located between and engaging said confronting inner portions of said cutters for urging said cutters laterally outwardly.

11. In a tubular string scraper: a main body having means for attachment to a running-in string and having a longitudinal passage therethrough; said body having opposed lateral slots extending inwardly from its periphery and opening directly into said passage, each slot being defined by top, bottom and side body walls; a tubular member in said passage extending across said slot for conducting drilling fluid through said body; opposed cutters slidable laterally in said slots, each cutter being engageable with all walls of its slot to prevent longitudinal and transverse movement of said cutter with respect to said body and being guided in its lateral movement by all walls of its slot, said cutters having concave inner portions extending partially around said tubular member and providing opposed inner side flanges on each of said cutters on opposite sides of and astride said tubular member, said flanges being slidable along the sides of said slots; and yieldable means common to said cutters and

located between and engaging said side flanges to urge said cutters laterally outwardly.

12. In a tubular string scraper: a main body adapted for attachment to a running-in string and having a longitudinal passage therethrough; said body having opposed lateral slots extending inwardly from its periphery and opening into said passage, each slot being defined by top, bottom and side body walls; a tubular member in said passage extending across said slot for conducting drilling fluid through said body; cutters slidable laterally in said slots, each cutter being engageable with all walls of its slot to prevent longitudinal and transverse movement of said cutter with respect to said body and being guided in its lateral movement by all walls of its slot, said cutters having concave inner portions extending partially around said tubular member and providing opposed inner side flanges on said cutters on opposite sides of said tubular member; and a plurality of springs between said opposed side flanges on opposite sides of said tubular member, each spring engaging said opposed side flanges to urge said cutters in opposite directions laterally outwardly.

13. In a tubular string scraper: a main body having means for attachment to a running-in string and having a longitudinal passage therethrough; said body having a lateral slot extending inwardly from its periphery and opening directly into said passage throughout substantially the entire length of said slot; a tubular member in said passage extending across said slot for conducting drilling fluid through said body; a cutter slidable laterally in said slot and having inner portions extending partially around and astride the tubular member, said inner portions being slidable along the sides of said slot; and means urging said cutter laterally outwardly.

14. In a tubular string scraper: a main body having means for attachment to a running-in string and having a slot opening through the periphery of the body at diametrically opposite sides thereof; said body having a central longitudinal passage therethrough opening into the upper and lower ends of said slot; a tubular member in said passage extending across said slot for conducting drilling fluid through said body; opposed cutters on diametrically opposite sides of said tubular member and slidable laterally in said slot and adapted to project in opposite directions beyond the periphery of said body, said cutters having scraping teeth disposed at least partially longitudinally of said body to scrape the tubular string upon rotation of said body; and means urging said cutters laterally outwardly of said body.

15. In a tubular string scraper: a main body having means for attachment to a running-in string and having slot opening through the periphery of the body at diametrically opposite sides thereof, said slot having parallel side walls; said body having a central longitudinal passage therethrough opening into the upper and lower ends of said slot; a tubular member in said passage extending across said slot for conducting drilling fluid through said body; opposed cutters on diametrically opposite sides of said tubular member and slidable laterally in said slot along its side walls and adapted to project in opposite directions beyond the periphery of said body, each cutter having inner portions extending partially around and astride said tubular member, said inner portions being slidable along the sides of said slot; and means common to said cutters and located between and engaging said inner portions for urging said cutters laterally outwardly.

16. In a tubular string scraper: a main body having means for attachment to a running-in string and having a slot opening through the periphery of the body at diametrically opposite sides thereof; said body having a central longitudinal passage therethrough opening into the upper and lower ends of said slot; a tubular member in said passage extending across said slot for conducting drilling fluid through said body; opposed cutters on diametrically opposite sides of said tubular member and slidable laterally in said slot and adapted to project in opposite directions beyond the periphery of said body, said cutters having scraping teeth disposed at least partially longitudinally of said body to scrape the tubular string upon rotation of said body; and yieldable means extending across the periphery of said tubular member from a cutter on one side thereof to a cutter on the opposite side thereof and engaging said cutters to urge said cutters in opposite directions laterally outwardly of said body.

References Cited by the Examiner

UNITED STATES PATENTS

1,011,384	12/11	Sly	175—291
1,372,894	3/21	Minton	175—291 X
2,603,163	7/52	Nixon	166—212
2,693,239	11/54	Emanuel	166—173
2,713,913	7/55	Ragan	166—173
2,743,781	5/56	Lane	166—170 X
2,836,251	5/58	Claypool et al.	166—173
2,857,141	10/58	Carpenter	166—174 X
3,088,532	5/63	Kellner	166—212 X
3,123,162	3/64	Rowley	166—212

FOREIGN PATENTS

106,451	1/99	Germany.

CHARLES E. O'CONNELL, *Primary Examiner.*

BENJAMIN HERSH, *Examiner.*