Oct. 10, 1961 W. P. ORR 3,003,558

METHOD OF REMOVING DEBRIS FROM WELL BORES

Original Filed Aug. 1, 1955 2 Sheets-Sheet 1

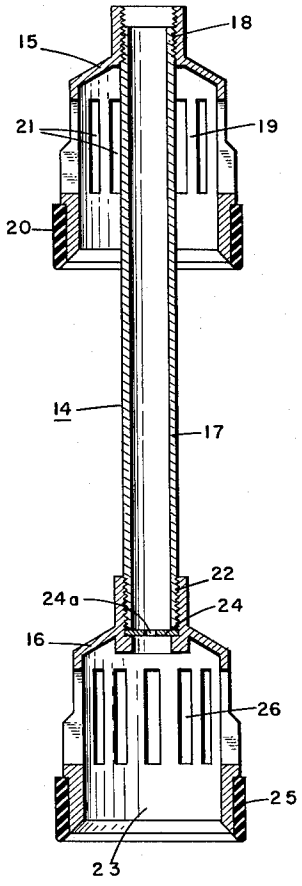


FIG. 1.

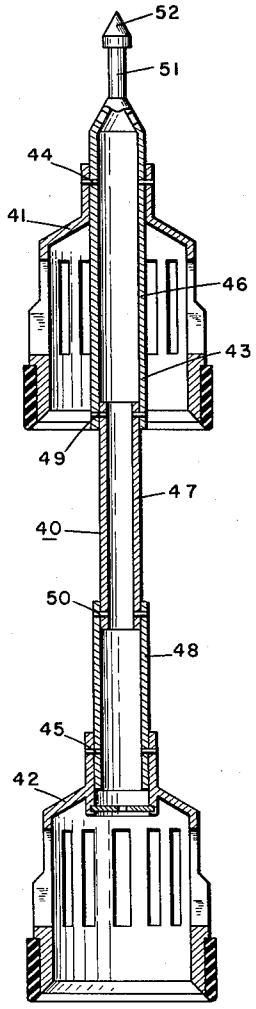


FIG. 5.

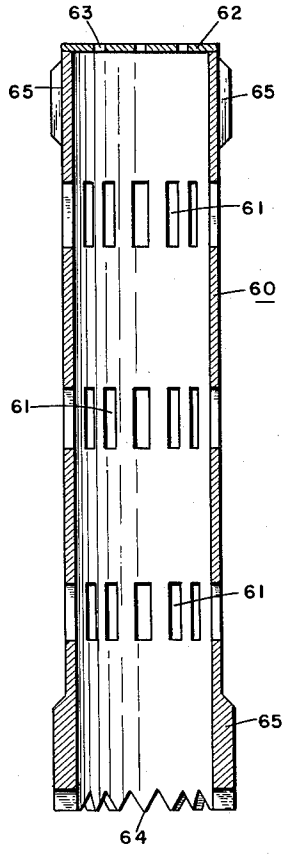


FIG. 6.

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FIG. 2.

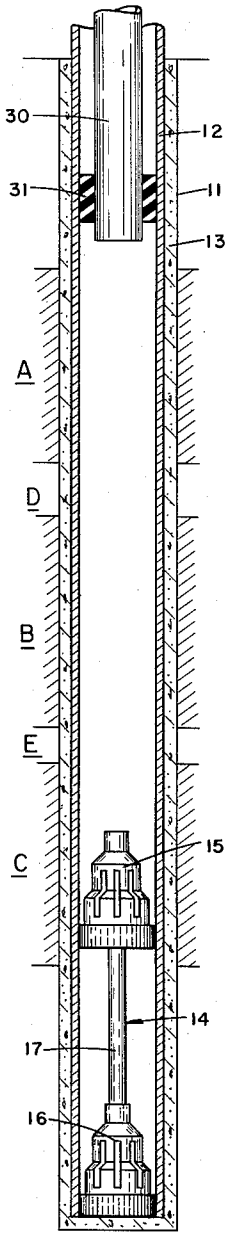


FIG. 3.

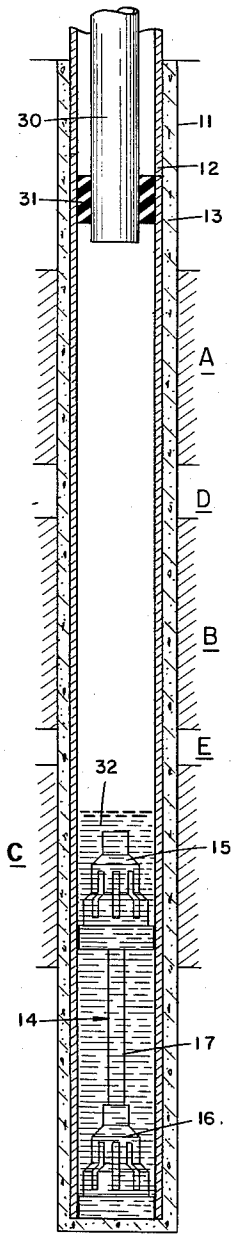
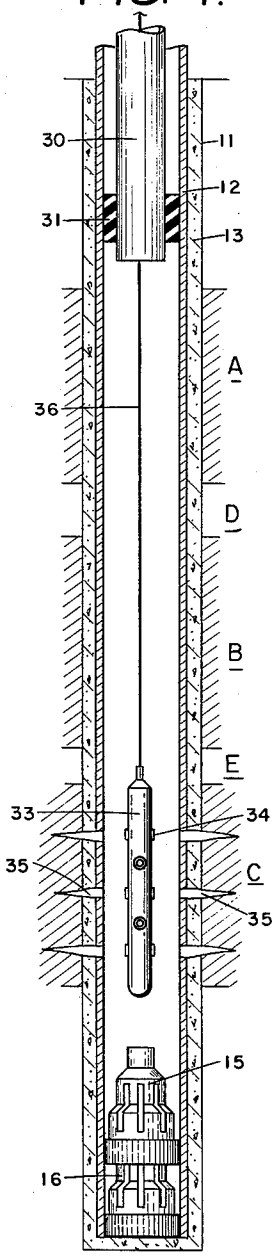


FIG. 4.



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3,003,558
METHOD OF REMOVING DEBRIS FROM WELL BORES

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Original application Aug. 1, 1955, Ser. No. 525,738, now Patent No. 2,902,095, dated Sept. 1, 1959. Divided and this application Oct. 9, 1957, Ser. No. 689,158
2 Claims. (Cl. 166—43)

The present invention is directed to method and apparatus for removal of debris from well bores. More particularly, the invention is directed to a method and apparatus for scraping the interior surface of well casing to remove debris therefrom. In its more specific aspects, the invention is directed to a method and apparatus for scraping the interior of a well casing and pushing and confining debris to the bottom of the well bore prior to running and setting tubing therein.

This application is a division of Serial No. 525,738, entitled "Removal of Debris From Well Bores," filed August 1, 1955, for Willis P. Orr, now U.S. Patent 2,902,095.

The present invention may be briefly described as a device for use in a well casing to remove debris and the like therefrom which comprises an elongated tubular mandrel provided with at least one or a plurality of spaced apart hollow cup-shaped debris removers attached to the mandrel. The debris removers are attached to the mandrel to face unidirectionally and are provided with lateral openings of a sufficient size for passage of fluid but of insufficient size for passage of debris.

The debris remover may suitably be made destructible or drillable or may be collapsed or telescoped on itself by constructing the tubular member of a destructible metal which may be disintergated chemically or the tubular member may be formed with a telescopic section slip joint which may be pinned together by a suitable frangible means such as shear pins, and the like, or by a releasable detaching means. When shear pins are used, the tubular member may be telescoped by setting down weight on the debris remover such as by lowering the tubing to rest on the debris remover a sufficient amount to rupture the frangible means.

The device is adapted for gravitational or forced travel through a well casing and may comprise an elongated tubular member suitably constructed of a destructible metal, such as aluminum, magnesium and the like. The elongated tubular member has an opening in its lower end for receiving and entrapping junk within the tubular member and is provided with a trap on or adjacent its upper end, the device having lateral openings for passage of fluid. The upper and lower ends of the tubular member are provided with downwardly facing open cup-shaped members for receiving and entrapping junk; the lower of the cup-shaped members communicates fluidly with the tubular member and the upper of the cup-shaped members provides an annular recess with the exterior surface of the tubular member.

The method of the present invention includes the completing of a well having a casing arranged therein in which a debris remover is inserted into the well casing and released for gravitational or forced travel through the major portion of the length of the casing to push debris ahead of the debris remover and/or to scrape the interior surface of the well casing. Thereafter a tubing is run in and set in the well casing following which the casing is perforated by lowering a perforator through the tubing and operating same to perforate the casing. After the tubing has been run in and prior to the perforation operation, at least a portion of the debris remover may be disintergated by flowing or introducing a sufficient

amount of a caustic solution, salt water, acid and the like into the casing to cause reaction with the destructible metal. By virtue of the construction of the debris remover wherein spaced apart cup-shaped members are employed, the debris remover is telescoped on itself to occupy a space in the well casing less than that ordinarily occupied.

The present invention will be further illustrated by reference to the drawing in which:

FIG. 1 is a sectional view of a debris remover for use in a well casing;

FIG. 2 shows the debris remover of FIG. 1 on the bottom of a well and a tubing run in and set;

FIG. 3 illustrates the destruction of the destructible portion of the debris remover of FIG. 1;

FIG. 4 shows perforating an interval in the well casing following the destruction of a portion of the debris remover and telescoping on itself;

FIG. 5 shows a modified debris remover provided with a telescopic section; and

FIG. 6 illustrates a preferred form of a debris remover of the present invention.

Referring now to the drawing and particularly to FIGS. 1 through 4, in which identical numerals will be employed to designate identical parts, numeral 11 designates a well bore drilled from the earth's surface to penetrate a plurality of hydrocarbon productive intervals having a casing 12 arranged therein and cemented in place with a primary cement job 13. Arranged for gravitational or forced travel in the casing 12 is a debris remover generally indicated by the numeral 14 comprised of a plurality of spaced apart cup-shaped members 15 and 16 arranged on a nipple or tubular mandrel 17 which suitably many be constructed of a destructible metal, such as aluminum or magnesium. The cup-shaped member 15 may be attached to the mandrel 17 by mating threads 18 or by other suitable means. The cup-shaped member 15 is downwardly facing and provides an annular recess 19 for receiving debris and junk. The lower periphery of the cup-shaped member 15 may be provided with an annular member 20 which may suitably be a resilient material, like rubber, for scraping along the interior surface of the casing 12. The cup-shaped member 15 is provided with a plurality of longitudinally extending slots or openings 21 to allow passage of fluid from within the space 19 into the casing 12 which will resist passage of debris from the space 19.

The cup-shaped member 16 is similar in construction to the member 15 and may be attached to the tubular member 17 by mating threads 22 or by other means. The cup-shaped member 16 is attached to the lower end of the mandrel 17 and provides a cup-shaped recess 23 which communicates fluidly with the tubular mandrel 17 by an opening 24 in plate 24*a* to retain debris but yet allow passage of fluid. Suitably the plate 24*a* may be completely closed, as desired. Like the cup-shaped member 15, the lower periphery of the member 16 may have an annular member 25 constructed of resilient material, such as rubber. The cup-shaped member 16 also is provided with a plurality of longitudinally extending slots or openings 26 for passage of fluid from within the space 23 into the casing 12 but which resists passage of debris. The slots 21 and 26 may be a plurality of openings of other shapes of sufficient number and size for passage of fluid but of insufficient size for passage of small particles of debris and junk.

Referring now specifically to FIGS. 2 to 4, the debris remover 14 has travelled gravitationally or has been forced to the bottom of the well or to a lower portion of the well and thereafter the tubing 30, which may be provided with a production packer 31, is run in and set in the casing 12.

It will be noted that the casing 12 penetrates a plurality of hydrocarbon productive intervals, such as A, B, and C from which hydrocarbons or other desirable fluids may be producing, the productive intervals being separated by non-productive intervals, such as D and E.

In FIG. 3 the debris remover 14 is immersed in a body 32 of caustic solution, such as sodium hydroxide, to cause destruction of the tubular mandrel 17 which causes the cup-shaped members 15 and 16 to collapse and assume the telescopic position shown in FIG. 4, the caustic solution having been removed from the casing 32 by opening the packer 31 and inserting a tubular member in the tubing 30 to reverse circulate out the body 32 of the caustic solution. The cup-shaped members may also be made of a material that will disintegrate in caustic, acid, or salt water solution.

Thereafter a perforator, such as a tubing gun perforator, designated by numeral 33, provided with a plurality of bullet or shaped-charge guns 34 is lowered on a wire line or cable 36 adjacent the interval C and operated or fired to form a plurality of perforations 35 through the casing 12, cement 13 and to penetrate and perforate the formation C in the space previously occupied by the debris remover as shown in FIG. 4. Production is then had through the perforations 35, up through the tubing 30 to the well head, not shown.

Referring now to FIG. 5, a debris remover designated generally by the numeral 40 is provided with a plurality of spaced apart downwardly facing cup-shaped members 41 and 42 which are generally of the construction of members 15 and 16 and are provided with longitudinally extending slots or openings. The spaced apart cup-shaped members 41 and 42 are attached releasably to a telescopic mandrel 43 by frangible means, such as shear pins 44 and 45. The mandrel 43 may suitably be constructed in sections 46, 47, and 48 which may be releasably connected together by frangible means, such as shear pins 49 and 50. The device of FIG. 5 is provided with a fishing neck 51 having a fishing spear 52 thereon for removal of the remover 40 with a grab tool (not shown) attached to a wire line and the like, also not shown. The other embodiments may also be provided with retrieving means, as desired.

By providing cup-shaped members releasably attached to the tubular mandrel and by having the tubular mandrel constructed with a slip joint or with telescopic sections as described, it is possible to collapse the cup-shaped members 41 and 42 on themselves by suitably setting down weight on the debris remover 40. This may be accomplished by dropping a weight in the casing before running in tubing or by setting down weight of the tubing 30 on the device 40 when it reaches a position as shown in FIG. 3.

It is advantageous to construct the device as shown in FIG. 5 since this construction eliminates the necessity for using a caustic soda solution or other chemical to disintegrate the tubular mandrel and/or telescope the structure.

The presence of caustic soda solution in the well may be detrimental and requires removal of same such as by circulating out or bailing since caustic soda solution may attack gun perforators or well logging devices constructed of aluminum.

Furthermore the device of FIG. 5 may be retrieved by fishing such as by engagement with a wire line tool and recovered for re-use.

Referring now to FIG. 6, numeral 60 designates an elongated member encompassing a debris or junk remover in accordance with the present invention. The elongated member 60 is suitably in the form of a tubular member provided with a plurality of lateral slots 61 which will allow fluid to pass freely therethrough but which will resist passage of debris.

The upper end of the tubular member 60 is suitably closed by a plate member 62 provided with a plurality of holes 63 for passage of fluid and for retaining junk. The tubular member 60 with the perforated plate 63 provides a trap in the interior thereof for junk. The lower end of the tubular member 60 may be provided with teeth or cutting members 64 which prevents rotation of the tubular member 60 if it is later desired to drill out the junk remover in accordance with this embodiment. Arranged on the upper and lower ends of the tubular member 60 are a plurality of stabilizing splines or fins 65 which are longitudinally extending on the tubular member 60.

The present invention is of considerable value and utility in that heretofore it was the practice to scrape or clean the interior surfaces of well casing to remove debris and junk by running in a debris remover or scraper attached to the tubing or to other equipment attached to the tubing. The present invention eliminates a substantial amount of manipulating the tubing by inserting into the casing and releasing a debris remover of the type described herein for gravitational travel through the casing. By dropping a junk pusher or debris remover in the hole during completion operations before perforating the casing using a tubing gun perforator, a round trip with the tubing or drill pipe to the bottom of the hole to insure that the hole is cleaned is saved. If the debris removed will not drop to bottom, it can be pushed to bottom with the tubing. The tubing then may be spaced above the debris remover as shown in FIGS. 2 to 4, inclusive, as desired without a pulling job. This is quite advantageous in that the heavy duty hoisting equipment may be moved off the hole and used elsewhere earlier than heretofore. Specifically, in a Texas field the junk pusher or debris remover, in accordance with the present invention, is dropped into the casing immediately after pulling the tubing after the stage cementing tol has been drilled out at a designated depth. A tool of this type is described and illustrated on page 2038 of the Composite Catalog of Oil Field and Pipeline Equipment, 20th edition, 1954–55. The tubing is then run with the tubing open-ended, as shown in the drawing, following the junk pusher to the bottom of the hole, if desired, and thereafter the tubing is picked up, the well head connection, commonly called a Christmas tree, installed and the rig moved off. A well logging device, such as tubing gamma ray logger, may be run and the casing perforated at a particular selected interval using a tubing gun. In accordance with this invention, the hole is cleaned of junk and a trip to the bottom with the tubing is saved. Thus in accordance with the present invention, it is unnecessary to attach junk and debris removers to tubing strings for cleaning and/or scraping the interior surface of well casing.

The device of FIG. 6 is employed in a similar manner to that of the devices of FIGS. 1 to 5 and may be employed by releasing the junk pusher in the hole immediately after puling the tubing.

Specifically, the device of FIG. 6 has been used successfully in a Texas oil field for removing junk and/or debris from service wells.

The device of FIG. 6 may suitably be constructed of a tubular member approximately 18 inches in length slotted longitudinally and provided wieth quarter inch holes in the plate member closing the upper end. This junk pusher is not to be restricted to particular dimensions since a junk pusher may be constructed having an overall length of about 25 inches, an outside diameter of about 4⅜ inches with the stabilizing splines or fins having an outside diameter of about 4⅓ inches.

The present invention is of commercial utility and has been used successfully on many occasions in cleaning wells of junk and removing debris from the interior surfaces of the casing which otherwise would prove harmful to tools and equipment lowered in the casing.

The debris removers, such as 15 and 16, may suitably be constructed of cast iron while the tubular mandrel 17 may suitably be constructed of aluminum. If desired, the members 15 and 16 might also be constructed of a de-

structible or drillable metal since it may be desired to deepen the well subsequently to the described operations.

The present invention insures that the hole is clean, prevents sticking of pipe and/or endangering rubber packers and other equipment. It is, therefore, of utility in cleaning wells.

The nature and objects of the present invention having been completely described and illustrated, what I wish to claim as new and useful and to secure by Letters Patent is:

1. A method for completing a well having a well casing arranged therein which consists of inserting a telescopically collapsible debris remover into and forcing said debris remover to travel downwardly through said casing in contact with the inner surface thereof throughout its length to push ahead and simultaneously entrap debris with said debris remover whereby the inner surface of said well casing is scraped, said debris remover traveling to and remaining on botom of the well, placing sufficient force on said debris remover whereby the debris remover is caused to collapse and telescope and occupy less space than it occupied before being collapsed, and

thereafter running and setting tubing in said casing spaced above said collapsed debris remover, thereby avoiding a round trip of said tubing.

2. A method in accordance with claim 1 in which said well casing is perforated by lowering a perforator through said tubing into the space in the casing between the collapsed debris remover and the lower end of the tubing and operating said perforator in said space.

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