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DEVICE FOR SCRAPING AND TESTING WELL TUBING

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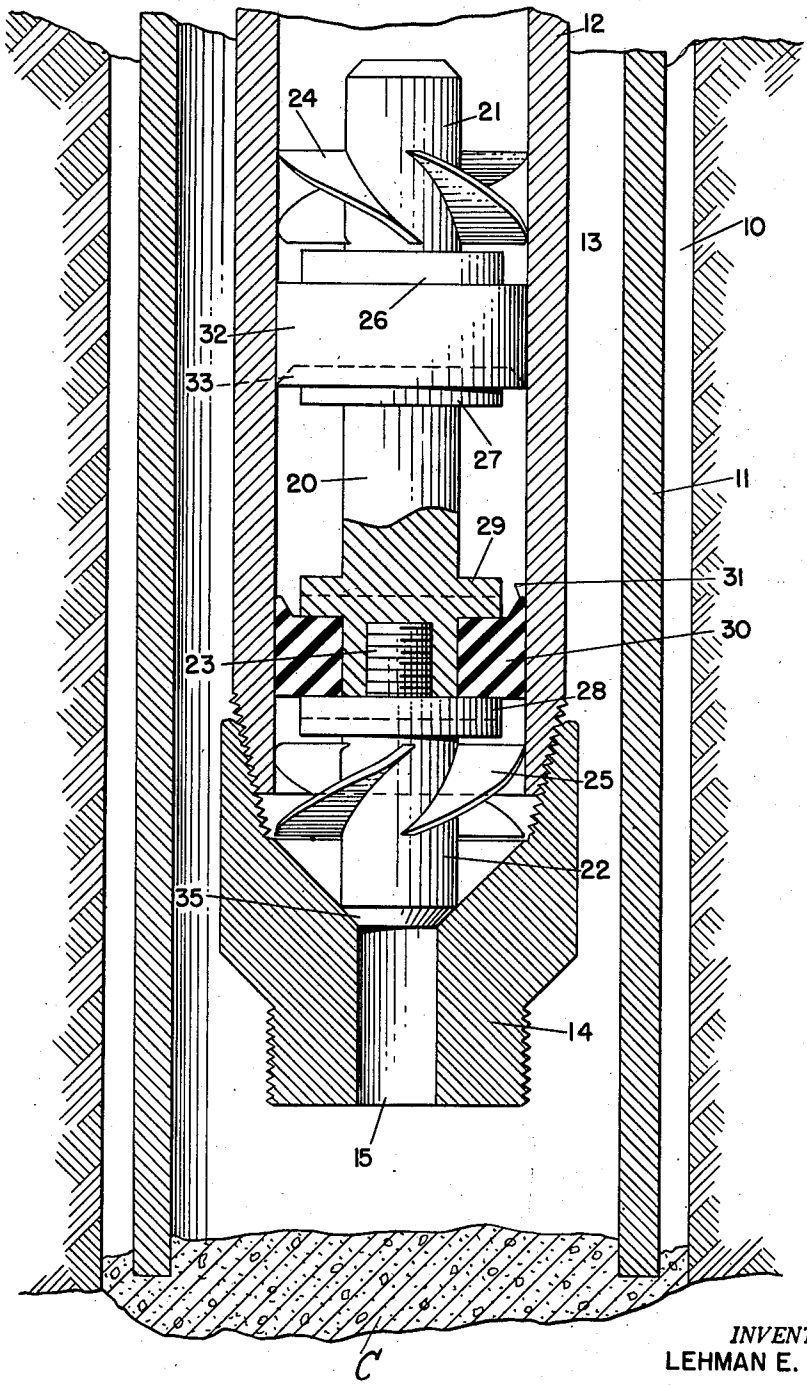

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DEVICE FOR SCRAPING AND TESTING WELL TUBING

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1

The present invention relates to a tool or device adapted for the pressure testing of well tubing and for scraping from the inner wall of well tubing any contaminants collected thereon. In particular the device is designed to be forced into and out of the well tubing by hydraulic pressure in order to scrape contaminants from the inner wall of the tubing prior to finishing a well for production. In addition to the scraping feature of the invention, a cooperating element is provided which permits the well tubing to be tested under pressure in order to determine whether or not it can be used under high pressures.

In order to better understand the invention, it is believed an explanation of oil well drilling practices will be found helpful. After a well has been drilled, the well casing is placed therein and in order to position the casing within the well bore it is customary to seal the lower end of the casing to the bore in the vicinity of the particular producing formation. The sealing is effected ordinarily by pumping a neat cement slurry into the casing for passage downwardly therethrough and out of the open lower end of the casing to build a sealing layer of cement between the casing and the wall of the bore hole. After the casing has thus been sealed, communication is provided between the inner casing passageway and the producing formation by perforating the casing and the cement adjacent thereto which is done by what is commonly known as gun perforating.

It occasionally happens that the cement sealing operation is not properly effective due to the fact that the cement slurry which has been supplied to the casing for this purpose often channels or by-passes portions of the annulus between the lower end of the casing and the well bore, and it then becomes necessary to resort to what is known as squeeze-cementing or forced cementing in order to effect a proper seal. Also when a water or gas formation is found to be adjacent the desired producing formation, it is sometimes desirable to seal off the formations in order to prevent the vertical flow of gas or water from the adjacent formations into the producing formation and squeeze-cementing is resorted to in order to overcome this problem.

In order to effect the squeeze-cementing, the well tubing which is of smaller diameter than that of the casing is inserted into the casing and it is provided adjacent its lower end with what is commonly known as a packer to pack off the annulus between the well tubing and the casing in order to limit the upward passage of the cement in the annulus, and a cementing head is provided below the packer through which the cement is distributed to the annulus. After the tubing is positioned within the casing, cement is admitted to the tubing from the surface and forced out of the cementing head through perforations in the casing into the annulus between the well bore and the casing in order to seal the casing as desired. After the squeeze-cementing has been accomplished, it is necessary to drill through the cement accumulated in the lower part of the casing and again effect the perforating step in order to provide communication with the desired producing formation.

2

The presssure required to squeeze-cement the well is of the order to 5000 pounds per square inch, and before a squeeze-cementing operation is started, it is desirable to test the tubing utilized for the squeeze-cementing in order to determine if it will be able to withstand the high pressure.

In general, the tool or device is made up of support which has at its upper and lower ends similar scraping elements and also similar liquid sealing elements. The scraping elements are provided with scraping vanes and are removably secured to the support. The liquid sealing rings may be of any desired flexible or resilient material to effect a seal with the inner wall of the tubing as the device is passed through the tubing under the pressure of the hydraulic medium used. The flexible rings are preferably provided with vertical flanges which in effect form cup shaped receptacles to prevent the passage of the hydraulic fluid beyond one or the other of the rings depending on the movement of the device into or out of the tubing. The sealing rings function as pistons to force the scraper into or out of the tubing under the force of the hydraulic medium. The sealing rings are removably secured to the support in order to readily effect their removal and replacement.

A cooperating element or stop is provided at the lower end of the tubing to limit the movement of the device beyond this point at which time one or the other of the seal rings will operate to limit the flow of the hydraulic medium and the pressure will begin to build up within the tubing. Consider the tubing to have been used in a squeeze-cementing operation and that it has acquired a coating of cement as the device is hydraulically forced into the well tubing under pressure, the scraper will clean the inner wall of the tubing as the device passes therethrough, and when the device reaches the stop at the lower end of the tubing, the continued application of the hydraulic medium will increase the pressure in

the tubing until the testing pressure of the tubing is reached, for example, until a pressure of 5000 pounds per square inch is reached and the tubing tested. After the tubing has been tested, the hydraulic pressure is released from the tubing and the connections are changed at the surface to supply pressure to the annulus between the tubing and the casing so that the hydraulic medium, for example, drilling mud enters the tubing at its bottom to force the scraper upwardly and out of the tubing. In practice, it has been found expedient to first test the tubing which is to be used in the squeeze-cementing prior to effecting the squeeze-cementing and then effect a test after the squeeze-cementing to determine whether the tubing can withstand the well production pressure.

Referring to the single figure of the drawings, which is partly in section to show details, the well bore is indicated at 10 and has a casing 11 disposed therein and in spaced relation therewith, while the well tubing 12 is positioned within the casing also in spaced relation with the casing providing an annulus 13. A hollow plug 14 which is internally screw threaded at its upper end is removably secured to the lower end of the tubing 12 and may be provided with a screw threaded area at its lower end in order to be adapted to receive other tools used in well drilling operations. The principal function of the hollow plug 14, however, is in the provision of a drilled out portion 15 which is of sufficiently small diameter to prevent further downward movement of the testing and scraping device and operates as a stop for the lower end of the device, but permits fluid to flow therethrough.

The testing and scraping device comprises a support 20 having at its upper and lower ends respectively extensions 21 and 22 which are removably secured to the support. The extensions are similar in construction and as shown in connection with the lower extension 22, each is provided with a screw threaded end 23, to permit the extensions to be removably secured to the support. The upper extension 21 is provided with a plurality of vanes 24, while the lower extension 22 is provided with a plurality of vanes 25. The vanes of each extension are similar, but it will be noted that the vanes 24 of the upper extension radiate therefrom in a direction opposite to the vanes of the lower extension 22. This opposed relationship of the vanes on the scraping elements provides an arrangement whereby the scraping tool is prevented from rotating when it is forced down into the tubing and thus effects a more positive scraping action. It will be understood when the tool is inserted in the tubing 12 that both the tubing and casing 11 will contain liquid, then as the tool 20 is forced downwardly by liquid pressure it will force liquid ahead of it through the lower end of the tubing and cause its circulation through the casing. Thus the upper set of vanes 24 and the lower set of vanes 25 will both be in contact with fluid at all times and because of the opposed relationship of the sets of vanes, the tool will be prevented from rotating. The upper extension is provided with a laterally extending flange portion 26 while the support 20 is provided with a cooperating laterally extending flange 27. Similarly the lower extension 22 is provided with a laterally extending flange 28 while the support has a cooperating laterally extending flange 29.

Referring to the lower portion of the figure which is partly in section, it will be seen that the extension 22 is screw threaded into the lower end of the support 20 positioning the flanges 28 and 29 in spaced relation. It will be understood that the upper extension 21 is assembled on the support 20 in a manner similar to that of the extension 22. A flexible sealing member 30 is rigidly held between the flanges 28 and 29 and is provided with an upstanding flange 31 providing in effect a cup shaped receptacle which, as fluid is admitted to the tubing 12, prevents the passage of fluid through the tubing beyond the sealing member 30 which then functions as a piston to force the tool toward the bottom of the tubing. It will be understood, of course, that a similar sealing member 32 is provided between the flanges 26 and 27 at the upper end of the device and has a depending flange 33 forming a cup shaped receptacle. In operation, when the fluid is admitted to the tube 12, it will pass the upper end of the scraper and be limited in its passage by the flanges 31 of the sealing ring 30 and the flanges 31 will be flexed outwardly to prevent the passage of fluid below the seal ring and force the tool into the tubing. After the scraper has reached the bottom of the tubing, its lower end 35 is designed to seat about the upper end of drill 15 and prevent further downward movement of the device through the tubing. After the movement of the device is stopped, the further application of hydraulic pressure will increase the pressure in the tubing and by continuing the pressure, the tubing can be tested to the desired degree as of the order of 5000 p. s. i. After the tubing has been tested or after it has been scraped, the supply of liquid to the upper end of the tubing 12 is cut off and directed into the annulus 13, the liquid passing downwardly therethrough and upwardly through the drilled out portion 15 into the inverted cup shaped receptacle of sealing ring 33 to force the scraper upwardly and out of the tubing. It will of course be understood that the lower end of the casing 11 will be plugged off during the cementing operation by the deposit of cement C and thus provide for circulation of the fluid from the annulus 13 upwardly through the hollow plug 14 and tubing 12.

In the above detailed description of the preferred embodiment of the invention, the upper and lower scraping elements are generally symmetrical as are the flexible sealing rings, and the general arrangement of the upper scraper and the upper sealing ring is symmetrical with that of the lower scraper and the lower sealing ring. It is preferred to embody the invention in this particular design of device since its use can be made fool-proof in that either end of the device may be inserted into the tubing and the device used in the testing and scraping operations. Of course it will be understood that in its broader aspects various types of scraping elements, as well as various types of flexible or resilient seal rings, could be used and the function of the invention carried out. The invention in its broader aspects can be carried out by the use of one scraping and one seal ring positioned in cooperating relation on the support.

The manner of securing the seal rings between the laterally extending flanges has an advantage, particularly when using the device with small gauge tubing since the rings while they are under compression are not subject to further expansion due to mechanical or hydraulic forces. This prevents the sealing rings from being expanded by the pressure of the hydraulic fluid

to such an extent that they are apt to stick against the tubing wall.

I claim:

1. A device adapted for testing and scraping well tubing, which comprises an elongate support, a set of tube scraping elements on each end of said support and extending laterally therefrom, a pair of resilient seal rings on said support between the sets of scraping elements, said seal rings being adapted to be forced into sealing engagement with the inner wall of the tubing by a hydraulic medium admitted to the well tubing and to move the device into and out of the tubing under the pressure of the hydraulic medium.

2. A device adapted for testing and scraping well tubing which comprises an elongate support, a pair of flanges extending laterally from the support, one spaced from one end and the other spaced from the other end of the support, an extension removably secured at each end of the support, each extension having a laterally extending flange adjacent its inner end, one extension flange providing a space with one of the support flanges and the other extension flange providing a space with the other support flange, a resilient seal ring positioned in each of said spaces and adapted to be forced into sealing engagement with the inner wall of the tubing and a set of laterally extending scraping elements on each extension.

3. A device adapted for testing and scraping well tubing which comprises an elongate support, a pair of flanges extending outwardly from the support, one spaced from one end and the other spaced from the other end of the support, an extension removably secured at each end of the support, each extension having a laterally extending flange adjacent its inner end, one extension flange providing a space with one of the support flanges and the other extension flange providing a space with the other support flange, a resilient seal ring positioned in each of said spaces adapted to be forced into sealing engagement with the inner wall of the tubing, a set of vaned scraping elements on each extension extending laterally therefrom and at an angle to the longitudinal axis of the extension, the scraping elements of one extension being disposed at an angle opposite to that of the scraping elements of the other extension.

4. A device adapted for testing and scraping well tubing which comprises an elongate support, a pair of flanges extending outwardly from the support, one spaced from one end and the other spaced from the other end of the support, an extension removably secured at each end of the support, each extension having an outwardly extending flange adjacent its inner end, one providing a space with one of the support flanges and the other providing a space with the other support flange, a resilient seal ring in each of said spaces, a vertical flange on each seal ring, one vertical flange extending in a direction opposite to the other vertical flange, one of said vertical flanges being adapted to be forced in contact with the tubing wall when a hydraulic medium is admitted to the upper end of the tubing and force the device to the bottom of the tubing and the other vertical flange adapted to be forced in contact with the well tubing when the hydraulic medium is supplied to the lower end of the tubing to force the device to the top of the tubing, and a hollow plug at the lower end of the tubing to stop the downward movement of the device and permit the tubing to be tested by continuing the supply of the hydraulic medium to the upper end of the tubing.

5. A device for testing and scraping well tubing, which comprises an elongate support, a set of vaned scraping elements fixed to said support adjacent one end thereof and extending laterally therefrom at an angle to the longitudinal axis of the support, another set of vaned scraping elements fixed to said support adjacent its other end and disposed at an angle opposite to that of the scraping elements of the other set, and a seal ring on said support between the sets of scraping elements and adapted to be forced into sealing engagement with the tubing wall by pressure contact with hydraulic medium used to move the device into or out of the well tubing.

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