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WALL CLEANING PLUG

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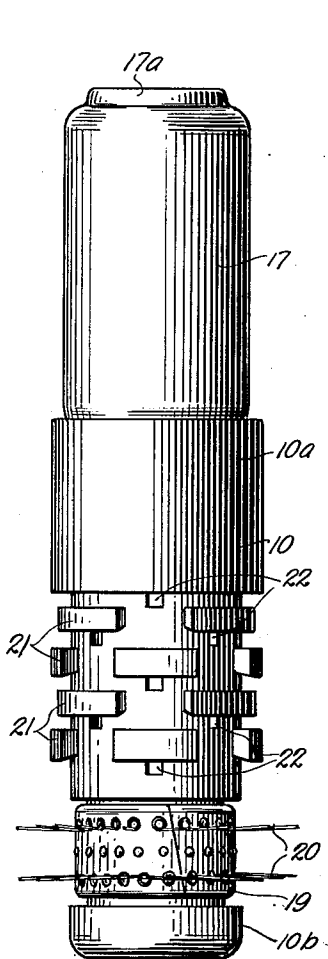


Fig. 1.

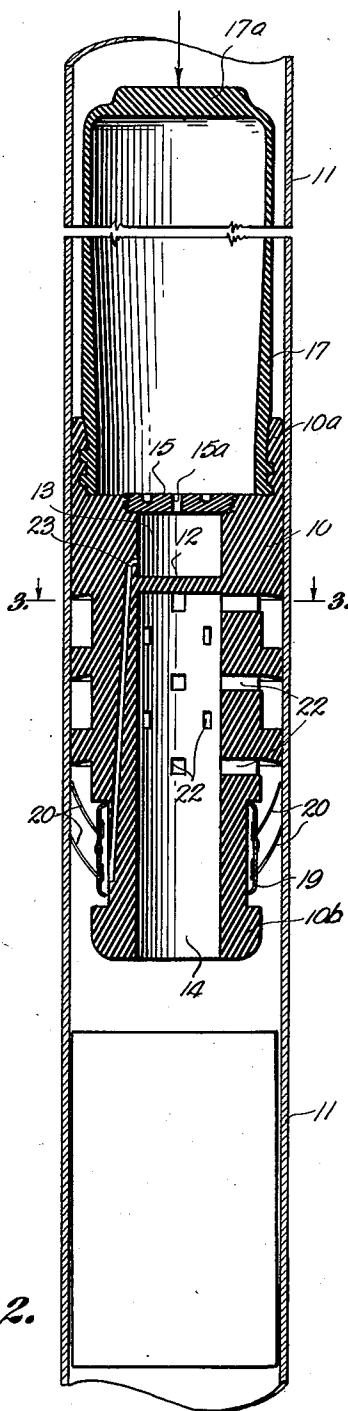


Fig. 2.

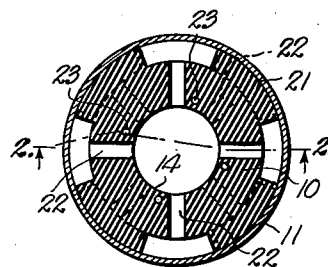


Fig. 3.

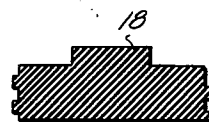


Fig. 4.



Fig. 5.

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UNITED STATES PATENT OFFICE

2,567,475

WALL CLEANING PLUG

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17 Claims. (Cl. 166—18)

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This invention relates to improvements in wall cleaning plugs and refers more particularly to plugs which may be used effectively during an oil or gas well cementing operation, or for removing substances accumulated on the inside wall of any type of pipe or tubing.

The invention will be described in the removal of accumulated mud and cement from the inside of an oil well casing, but it is not intended that the explanation restrict it to this purpose or function.

Plugs now in use rely solely upon the scraping action of the tightly fitting walls of the plug and casing. The plug which is the subject of this invention supplements the scraping action of the plug with auxiliary abrading elements adapted to loosen the film or scale of mud and cement by supplying a lubricant or softening liquid ahead of the plug during its travel through the pipe or casing.

An object of the invention, therefore, is to provide a plug which more effectively cleans the wall of the casing during its travel from the top to the bottom of the well.

Another object is to provide a plug equipped with spring wire abrading elements which serve to loosen accumulations on the casing wall.

A further object is to provide a hollow plug having passageways from the outer periphery to its inner chamber, permitting disposal of material scraped from the casing.

A still further object is to provide a plug with a lubricant reservoir and ducts for feeding the lubricant onto the periphery of the plug adjacent its front end to assist the abrading elements in loosening accumulated material from the casing wall.

Other and further objects will appear from the following description.

In the accompanying drawings which form a part of the instant specification and are to be read in conjunction therewith, and in which like reference numerals indicate like parts in the various views,

Fig. 1 is a side view of a plug embodying the invention.

Fig. 2 is substantially a central vertical section taken along the line 2—2 in Fig. 3 in the direction of the arrows to show one of the longitudinal ducts through which lubricant is delivered to the periphery of the plug.

Fig. 3 is a view taken along the line 3—3 in Fig. 2 in the direction of the arrows,

Fig. 4 is a sectional view of a closure used in

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place of the collapsible reservoir at the top of the plug, and

Fig. 5 is a sectional view of a closure used with a collapsible reservoir when a lubricant is not employed.

Referring to the drawings, the casing wall cleaning plug consists of a body portion 10 whose upper diameter fits snugly within the well casing 11. The body is hollow, having a cylindrical opening running longitudinally from end to end. A partition wall 12 extends transversely across this central chamber portion into an upper chamber 13 and a lower chamber 14. The upper end of chamber 13 is threaded to receive closure 15 having a central duct 15a or the blank closure member 16 shown in Fig. 5.

The upper portion of the body is flanged as shown at 10a which is internally threaded to receive the externally threaded open end of the collapsible reservoir 17. When the plug is run without the collapsible reservoir, blank plug 18 shown in Fig. 4 is screwed into the threaded flange 10a. The reservoir or container 17 is preferably constructed of a flexible material such as rubber, resilient plastic or the like, its lower wall being somewhat thicker than its upper wall and a thickened top portion 17a designed to collapse within the container to drive out or discharge the fluid with a piston action as it collapses.

Near the lower end of the plug, or what may be termed as its front or forward end, is formed an annular restriction or valley in which is fitted a collar 19. This collar has two rows of peripheral perforations through which extend wire scratchers 20. The inner ends of the scratcher elements are riveted centrally within the collar, the free ends pass through the holes and extend radially therefrom. The length of the wire scratchers is such that they must be bent back under tension in order to be confined within the casing and, due to this spring tension imposed by being restricted within the casing, abrade the casing wall. This abrading element made up of the collar and wire scratchers is preferably of the type disclosed in my application for patent, Serial No. 627,013, filed November 11, 1945, now abandoned. It is easily removed and replaced since the collar is split longitudinally.

Between the scratcher and the upper portion of the body which has substantially the diameter of the casing is a portion of somewhat less diameter upon which are formed a plurality of scraper elements 21. The outer surfaces of these scrapers are arcuate in shape and the scrapers have a radial depth which causes them to fit snugly

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against the casing wall. Below the scrapers and at intervals below the lower shoulder portion of the body member are located passageways 22 which communicate between the periphery of the plug and the hollow inner chamber 14. The lower walls of the scraper are curved slightly to effect a free flow of liquid and suspended solids through the passageway. Communicating between the upper chamber 13 and the periphery of the plug, preferably in the vicinity of the auxiliary abrading elements, are longitudinal ducts 23 through which fluid lubricant or liquid adapted to retard setting the cement is passed from the reservoir 17 into the space between the plug and casing wall.

The plug is designed to be used in a number of different forms. If it is desired to run the plug as a conventional cementing plug, reservoir 17 is removed and closure 18 is screwed into the threaded flange of the body. If it is desired to run the plug with a reservoir attached, but without use of a fluid lubricant, apertured disk 15 shown in Fig. 2 is replaced by closure 16 shown in Fig. 5 and the plug run as a conventional cementing plug.

The preferred operation, however, is with reservoir 17 attached to the body and apertured disk 15 screwed into the upper end of the plug as a top partial closure for chamber 13. An aqueous sugar or molasses solution or other liquid which has both lubricating properties and the property of retarding setting of the cement is placed in the reservoir. The plug is introduced into the casing at the well head in any cementing operation after the cement mix has been charged and is ready to be placed by the introduction of drilling fluid under pressure behind the plug. The plug moves downwardly through the casing due to the differential pressure ahead and behind the plug, forcing the cement downwardly as it proceeds. The scratcher elements 20 abrade the walls of the casing, loosening accumulations of mud and cement during the plug's travel. The pressure of the drilling fluid on the top of the reservoir forces the liquid in the reservoir slowly through aperture 15a in disk 15 into chamber 13 and thence downwardly through ducts 23. This fluid is discharged onto the periphery of the plug adjacent its lower end and preferably in the zone where the scratcher elements operate. The fluid is applied to the wall of the casing by the scratchers throughout its travel softening mud accumulations, and mixing with and retarding setting of the cement film and rendering it more easily removable thereafter. The suspension of water and solids is scooped into passageways 22 by scraper elements 21, and is discharged into the hollow chamber 14 of the body. From the chamber 14 the suspension is discharged from the lower open end of the chamber to be mixed with the cement forced ahead of the plug.

The lower end or nose of the plug shown at 10b in Fig. 1 is of smaller diameter than the plug body as shown in Figs. 1 and 2, permitting free circulation of the solids suspension about the nose of the plug.

While the plug and its operation have been explained with reference to cementing of oil and gas wells, it is contemplated as well that the plug may be used in scraping and cleaning the interior of other tubular conveyers such as pipe lines, refinery pipes or for industrial purposes where the efficiency of transporting pipes or pipe equipment is reduced by solid accumulations.

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The character of the fluid used in the reservoir may be altered to furnish not only lubrication for the plug but a constituency which will soften or dissolve the particular solid accumulation within the pipe to be cleaned.

Thus it will be seen that an improved type of wall cleaning plug has been devised, one which is particularly adapted for use in cementing oil wells, for cleaning pipe lines or removing solid accumulations from pipes of any kind. As suggested, the inventive novelty resides primarily in the use of abrading elements adjacent the front end of the plug and a fluid container or reservoir attached to the rear end. The fluid in the reservoir is discharged at the forward end of the plug by collapsing the reservoir due to the differential pressure upon the rear and front ends of the plug. The hollow interior and radial ducts with the staggered circumferentially arranged scraping elements offers a construction for effectively removing solids which are scraped from the inner walls of the pipe.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims. It is further obvious that various changes may be made in details within the scope of the claims without departing from the spirit of the invention. It is therefore to be understood that the invention is not limited to the specific details shown and described.

Having thus described my invention, I claim:

1. A casing cleaner of the character described, comprising a traveling plug having a hollow bore, a plurality of scraping lugs on the exterior of the plug adapted to engage the interior of the casing to be cleaned, said lugs arranged in circumferential rows, the lugs in each row being spaced circumferentially from one another and the lugs in adjacent rows being staggered relative one another, and radial ducts through the plug connecting the bore thereof with the space outside of the plug, each duct disposed forwardly of one of the lugs.

2. A casing cleaner of the character described comprising a traveling plug carrying outwardly extending wire whiskers adapted to engage the interior of the casing to be cleaned, and scraping lugs on the exterior of the plug adapted to engage the interior of the casing rearwardly of the whiskers, said lugs arranged in circumferential rows, the lugs in each row being spaced circumferentially from one another and the lugs in adjacent rows being staggered relative one another, said plug having a hollow bore and radial ducts through the plug connecting the bore thereof with the space outside of the plug, each duct disposed forwardly of one of the lugs.

3. A casing cleaner of the character described, comprising a traveling plug having a hollow bore, a plurality of spaced-apart scraping lugs on the exterior of the plug adapted to engage the interior wall of the casing to be cleaned, substantially radial ducts through the plug connecting the bore thereof with the space outside of the plug, each duct disposed forwardly of one of the lugs, a fluid reservoir carried by the plug, and means for transferring the fluid from said reservoir into the space ahead of the lugs as the plug advances.

4. A casing cleaner of the character described comprising a traveling plug having on its exterior a plurality of scraping lugs adapted to engage

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the interior of the casing to be cleaned, said lugs arranged in circumferential rows, the lugs in each row being spaced circumferentially from one another and the lugs in adjacent rows being staggered relative one another, a fluid reservoir carried by the plug, and means for transferring the fluid from said reservoir into the tube ahead of the lugs as the plug advances.

5. A casing cleaner of the character described comprising a plug adapted to travel through the casing under the influence of pressure behind the plug, an enclosed fluid reservoir carried by the plug, said reservoir having an outlet duct carried by said plug and opening into the region ahead of the plug, through which duct the contents of said reservoir are adapted to issue as the plug advances.

6. A casing cleaner of the character described, comprising a plug adapted to travel through the casing under the influence of pressure behind the plug, an enclosed fluid reservoir carried by the plug, said reservoir having an outlet port communicating with the space ahead of the plug, and said reservoir including means controlled by the pressure behind the plug for forcing the contents of the reservoir through said outlet port into said space as the plug advances.

7. A casing cleaner of the character described, comprising a piston-like plug adapted to travel through the casing under the influence of pressure behind the plug, a collapsible reservoir carried by the plug on its trailing side whereby the reservoir is subjected to the pressure behind the plug, said reservoir having an outlet port on the leading side of the plug through which its contents can issue into the region ahead of the plug.

8. A casing cleaner of the character described comprising a plug adapted to travel through the casing under the influence of the pressure behind the plug, a plurality of spaced-apart scrapers on the exterior of the plug adapted to engage the interior of the casing, a fluid reservoir carried by the plug, said reservoir having an outlet duct carried by the plug and opening into the space ahead of the scrapers, and means whereby the pressure behind the plug forces the contents of the reservoir through said outlet.

9. A casing cleaner of the character described, comprising a piston-like plug at least as large in diameter as the inside diameter of the casing to be run and adapted to travel through the casing under the influence of pressure behind the plug, said plug having thereon a forwardly projecting stem of reduced cross section, a plurality of lugs on the exterior of the stem adapted to engage the interior of the casing, said lugs arranged in circumferential rows, the lugs in each row being spaced circumferentially from one another and the lugs in adjacent rows being staggered relative one another, a fluid reservoir carried by the plug, said reservoir having an outlet duct fixedly positioned relative the plug and adapted to travel therewith, said duct opening into the region ahead of the plug and permitting the contents of the reservoir to issue into said region as the plug advances.

10. A casing cleaner of the character described, comprising a piston-like plug at least as large in diameter as the inside diameter of the casing to be run and adapted to travel through the casing under the influence of pressure behind the plug, said plug having thereon a forwardly projecting stem of reduced cross section, a plurality of lugs on the exterior of the stem adapted to engage

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the interior of the casing, said lugs arranged in circumferential rows, the lugs in each row being spaced circumferentially from one another and the lugs in adjacent rows being staggered relative one another, a fluid reservoir carried by the plug, a duct fixedly positioned relative the plug and adapted to travel therewith, one end of said duct communicating with the interior of said reservoir and the other end communicating with the space ahead of the plug, and means controlled by the pressure behind the plug for forcing the contents of the reservoir through said duct into said space as the plug advances.

11. A casing cleaner of the character described, comprising a piston-like plug at least as large in diameter as the inside diameter of the casing to be run and adapted to travel through the casing under the influence of pressure behind the plug, said plug having thereon a forwardly projecting stem of reduced cross section, a plurality of lugs on the exterior of the stem adapted to engage the interior of the casing, said lugs arranged in circumferential rows, the lugs in each row being spaced circumferentially from one another and the lugs in adjacent rows being staggered relative one another, a collapsible reservoir carried by the plug on its trailing side whereby the reservoir is subjected to the pressure behind the plug, and a duct fixedly positioned relative the plug and adapted to travel therewith, one end of said duct communicating with the interior of said reservoir and the other end communicating with the space ahead of the plug.

12. A casing cleaner of the character described, comprising a piston-like plug at least as large in diameter as the inside diameter of the casing to be run and adapted to travel through the casing under the influence of pressure behind the plug, said plug having thereon a forwardly projecting stem of reduced cross section, a plurality of lugs on the exterior of the stem adapted to engage the interior of the casing, said lugs arranged in circumferential rows, the lugs in each row being spaced circumferentially from one another and the lugs in adjacent rows being staggered relative one another, a collapsible reservoir carried by the plug on its trailing side whereby the reservoir is subjected to the pressure behind the plug, and a duct extending from said reservoir through said stem and opening, near the leading end of the stem, into the space within the casing.

13. A casing cleaner of the character described, comprising a piston-like plug at least as large in diameter as the inside diameter of the casing to be run and adapted to travel through the casing under the influence of pressure behind the plug, said plug having thereon a forwardly projecting stem of reduced cross section, a plurality of lugs on the exterior of the stem adapted to engage the interior of the casing, said lugs arranged in circumferential rows, the lugs in each row being spaced circumferentially from one another and the lugs in adjacent rows being staggered relative one another.

14. A casing cleaner as in claim 13 wherein said lugs have plow surfaces inclined forwardly and outwardly from the exterior of the stem.

15. A casing cleaner of the character described, comprising a piston-like plug at least as large in diameter as the inside diameter of the casing to be run and adapted to travel through the casing under the influence of pressure behind the plug, said plug having thereon a forwardly projecting stem of reduced cross section, a plu-

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ality of semi-rigid wall scraping lugs circumferentially arranged on the exterior of said stem to engage the interior of the casing, and outwardly projecting wire whiskers on the stem ahead of the lugs also engaging the interior of the casing.

16. A casing cleaner of the character described, comprising a piston-like plug at least as large in diameter as the inside diameter of the casing to be run and adapted to travel through the casing under the influence of pressure behind the plug, said plug having thereon a forwardly projecting stem of reduced cross section, a plurality of lugs on the exterior of the stem adapted to engage the interior of the casing, said lugs arranged in circumferential rows, the lugs in each row being spaced circumferentially from one another and the lugs in adjacent rows being staggered relative one another, said stem having a hollow bore and substantially radial ducts through the stem connecting the bore thereof with a space outside the stem, each duct disposed forwardly of one of said lugs.

17. A casing cleaner of the character described, comprising a piston-like plug at least as large in diameter as the inside diameter of the casing to be run and adapted to travel through the casing under the influence of pressure behind the

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plug, said plug having thereon a forwardly projecting stem of reduced cross section, a plurality of semi-rigid wall scraping lugs circumferentially arranged on the exterior of the stem to engage the interior of the casing, outwardly projecting wire whiskers on the stem ahead of the lugs also engaging the interior of the casing, said stem having a hollow bore and substantially radial ducts through the stem connecting the bore thereof with the space outside the stem, each duct disposed forwardly of one of said lugs.

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