

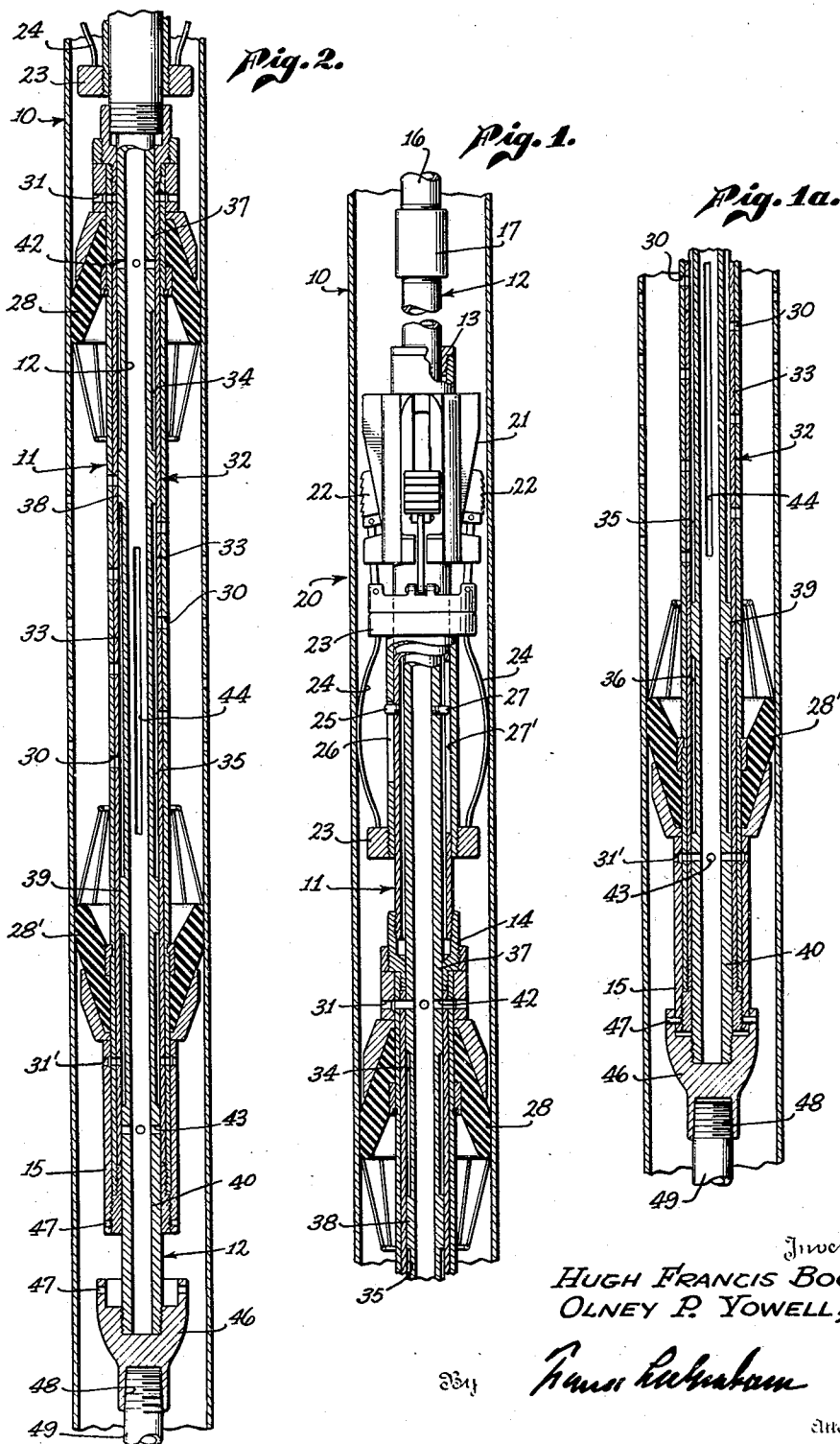
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CEMENTING TOOL

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CEMENTING TOOL

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This invention relates generally to oil well tools and particularly to such tools as are used for carrying out cementing operations in oil wells.

Present day oil well drilling and production practice makes necessary the performance of cementing operations at various points in the well above the bottom of the well. These cementing operations usually entail the forcing of cement through holes in the casing, such holes being either originally provided in the casing as in the case of combination production strings of casing or subsequently provided after the casing is in the well by any of the well known casing perforating methods. Such cementing operations require considerable time and equipment and with present day equipment necessarily result in leaving apparatus and cement in the well forming obstructions which must be drilled out. When it is desired to perform several cementing operations in the same well at various depths in the well, it is necessary for the ordinary apparatus to be run in and out of the well making several round trips in order to accomplish the multiple cementing operations. The cost of drilling the well and placing it on a production basis can be greatly reduced if these attendant disadvantages of ordinary cementing methods can be eliminated.

Generally it is an object of this invention to provide a new and improved tool for use in performing cementing operations in a well so that such operations may be carried out without the above mentioned and other attendant disadvantages of the ordinary present day apparatus for performing cementing operations. It is also an object of this invention to provide a cementing tool which may be used for performing multiple cementing operations in a well at different depths without removing the tool from the well until all of the cementing operations have been completed, thereby eliminating the necessity of several round trips of the cementing apparatus into and out of the well as is necessary with ordinary equipment.

It is a further object of this invention to provide a cementing tool which may be operated in the well without leaving any apparatus in the well and without leaving any objectionable bridges or obstructions of any kind in the well. In this connection it is an object to provide a tool which is entirely removable from the well and further to provide a tool which may be flushed clean of excess cement and which is so designed that excess cement may be circulated from and flushed out of the interior of the casing.

It is a further object of this invention to pro-

vide a tool which may be readily lowered or raised in the well and to accomplish this it is an object to provide a tool with controllable by-pass means for by-passing fluid in the well to opposite sides of the casing engaging packers forming part of the tool, or for preventing such by-passing as desired.

It is also an object to provide a cementing tool which can be operated to determine whether the tool itself is located in a region of perforated or non-perforated pipe, so that the tool can be used for accurately locating the so-called combination point or cementing point holes.

These and other objects will be apparent from the drawing and the following description thereof. Referring to the drawing which is for illustrative purposes only;

Fig. 1 is a view of the upper portion of the tool showing part of the tool in section;

Fig. 1a is a sectional elevation of the succeeding and lower portion of the tool;

Fig. 2 is a fragmentary sectional elevation of the tool showing the parts in different position than that of Figs. 1, 1a.

More particularly describing the invention the tool is shown inside of a well casing 10. Reference numeral 11 generally indicates an outer tubing or outer assembly which is comprised of a multiplicity of sections joined together to comprise the whole integrated assembly. Slidably mounted within the outer tubing is an inner tubular member 12 which is radially supported by means of the bushings 13, 14 and 15 located at the top, intermediate and lower parts of the outer tubing. The tool is adapted to be supported and raised and lowered within a well by means of the ordinary string of tubing or drill pipe, the lower end of which has been indicated by reference numeral 16, a connecting sleeve 17 being interposed between it and the upper end of the inner tubular member 12.

The outer tubing is provided at its upper end with an ordinary slip assembly 20 comprising the slip body 21 on which ride the slips 22 which are actuated by the member 23 provided with the casing engaging spring arms 24. The slip assembly is shown in inoperative position in Fig. 1 and held inoperative by means of the pin 25 in the ordinary inverted J slot 26, the pin being mounted on the outer tubular member. The inner and outer tubular members are keyed against relative rotative movement by pin 27 mounted in the inner tubular member which is receivable in a slot 27' in the outer tubing. Rotation of the inner tubular member to permit

the pin 25 to slide in the main or vertical portion of the slot 26 permits upward movement of the member 23 as the tool is lowered in the well, causing slip members 22 to ride upwardly on the slip body 21 and engage the sides of the casing to anchor or suspend the tool from the casing, all as known in the art.

Below the slip assembly the outer tubing is provided with two spaced packers 28 and 28'. These may be mounted on the outer tubing in any suitable manner and although the details of such mounting are shown in the drawing, a description of these details is unnecessary as forming no part of the invention. These packers are adapted to engage the casing 10 of the well and are positioned with their concave sides facing each other so that when they engage the casing any pressure between the packers in the space between the outer tubing and the casing of the well will cause the packers to more firmly engage the casing thereby preventing escape of fluid from said region upwardly past packer 28 or downwardly past packer 28'.

Intermediate the spaced packers the outer tubing is provided with a series of cement outlet openings 30 through which cement is forced when the tool is being used to perform a cementing operation as will hereinafter be explained. The outer tubing is also provided with a by-pass opening 31 above the upper packer 28 and with a second or lower by-pass opening 31' below the lower packer 28'. The purpose of these openings will also become apparent from subsequent description of the inner tubular member.

Intermediate the bushing 14 just below the slip assembly 20 and the bushing 15 at the lower end of the outer tubing, the outer tubing is provided with a lining 32 comprised of a plurality of wear resistant liners or inner jackets 33. These are provided for the purpose of securing a smooth, wear resistant surface for engagement with the inner tubular member so that fluid may not escape or be by-passed between those members past portions where the members are in engagement. The inner tubular member makes a close sliding fit with the inner lining 32 except where the inner tubular member has been provided with annular channels or recesses such as at 34, 35 and 36 to reduce friction. These annular channels or recesses on the inner tubular member leave what will be termed land portions or lining engaging portions 37, 38, 39 and 40. In the region of the land 37 the inner tubular member is provided with upper by-pass ports 42 which, when the tool is in the contracted or open position shown in Figs. 1, 1a registers with the upper by-pass openings 31 in the outer tubing. The inner tubular member is provided with lower by-pass ports 43 in the region of the land 40 which registers with the lower by-pass openings 31' when the tool is in the contracted or open position. In the region of the annular channel or recessed portion 35 the inner tubular member is provided with a cement slot or opening 44 which is in the region of the cement outlet ports 30 regardless of the position of the tool.

The lower end of the inner tubular member is provided with a shoe 46 which is adapted to accommodate shear pins 47 for temporarily connecting the inner tubular member and outer tubing and preventing relative movement of those members during lowering of the cementing tool in the well. The shoe may be provided with a threaded bore 48 to accommodate a tubing or tool 49 as desired.

From the above description it is apparent that when the tool is in the contracted or open position of Figs. 1, 1a the tool may be raised or lowered in a well full of liquid and the liquid by-passed to opposite sides of the packers 28, 28' through the by-pass openings 31, 31' in the outer tubing and the by-pass ports 42 and 43 in the inner tubular member which register with the respective by-pass openings 31, 31'. Thus the tool may readily be lowered or raised in the well when the inner tubular member is in the position relative to the outer tubing that it is shown in Figs. 1, 1a.

When it is desired to perform a cementing operation the tool may be adjusted to the position in which it is shown in Fig. 2, thereby closing the by-pass means to opposite sides of the packers 28, 28' by reason of the fact that the by-pass ports 42, 43 are caused to move out of registration with the by-pass openings 31, 31' thereby leaving the ports 30 and slots 44 as the only communicating openings between the exterior of the outer tubing and the interior of the inner tubular member.

In performing a cementing operation in a well the tool is first lowered in the well with the shear pins 47 securing the inner tubular member and outer tubing against relative movement. After the tool has been lowered to the desired point in the well, the slip assembly 20 may be set by partially rotating the string of tubing 16 on which the tool is suspended from the surface of the ground to bring the pin 25 into alignment with the major portion of the slot 26 as hereinabove described. Slight downward movement of the tool in the well will then cause the slip members 22 to engage the casing wall of the well and thereby anchor or suspend the tool from the casing. The pins 47 may then be sheared by jarring the inner tubular member through the medium of the string of tubing 16 leading to the surface of the ground, thereby making possible adjustment of the inner tubular member relative to the outer tubing.

The tool is then adjusted so that the inner tubular member is in the closed or extended position of Fig. 2 and circulation of liquid is established down through the string 16 and inner tubular member 12, the liquid flowing out through the slot 44 and openings 30 between the packers. It may be readily ascertained by thus establishing circulation whether the packers 28, 28' are on opposite sides of a region of perforated pipe. If circulation is impeded it is obvious that the tool is positioned in blank or unperforated pipe and it is only necessary to raise the tool a few feet, set the slips and again circulate with the tool in extended position in order to find the perforated region of the pipe.

After the perforated region of the casing has been found and the tool located with the packers on opposite sides of the perforated region of the casing as shown in Fig. 2, cement slurry or the like may then be introduced at the upper end of the string of pipe 16. The cement slurry is pumped down through the string of pipe 16 and it is preferable at first to have the tool in the open or contracted position of Fig. 1, 1a so that the liquid in the pipe 16 below the introduced cement may be flushed out above and below the packers of the tool through the by-pass ports 42-31 and 43-31', until the cement reaches the tool. This operation prevents the objectionable displacement of such liquid out through the perforated casing where it is desired to cement. After the

known quantity of liquid in the string of pipe 16 below the introduced cement has been circulated out and the cement has been pumped down to the tool, the tool is then extended to the closed or cementing position which is shown in Fig. 2 so that with continued pumping the cement will be forced down through the inner tubular member and out through openings 44 and 30 to the region between the packers 28 and 28' and then outwardly through the perforations in the casing to the desired region behind the casing.

After sufficient cement has been placed behind the casing the tool may be raised above the perforated region of the casing, the slips set, and liquid circulated down between the casing and the string of pipe 16 to flush out the tool and any cement in the casing above the packer 28' with the tool maintained in the closed position of Fig. 2. This liquid will pass the upper packer 28 and enter the tool through openings 30 and slot 44 thereby flushing out the tool and the casing. No pressure is put on the liquid below packer 28' by this operation. It is also possible to establish circulation downwardly through the string of pipe with the tool in the open or contracted position of Fig. 1, 1a to flush out the tool and the casing. It is further possible to reverse the circulation with the tool in this position by circulating downwardly between the casing and the string of pipe 16 in which case part of the circulated liquid will enter the tool through the upper by-pass ports 31-42 and some will pass packer 28 and enter the tool through openings 30 and slot 44.

Although the invention has been particularly illustrated and described and a particular method of operation described, it is not intended to limit the invention to the exact illustration and description, but is intended to cover such changes as come within the scope of the claims.

We claim as our invention:

1. In a well cementing tool, an outer tubing; a pair of spaced packers on said tubing adapted to engage a well casing; said outer tubing having an opening in its wall between said packers; an inner tubular member slidably mounted in said outer tubing and being adapted to be attached at its upper end to a string of tubing for operating the tool in a well, said inner tubular member having a port communicating with said opening in said outer tubing; and means for by-passing liquid to opposite sides of said packers, said means being closable by movement of said inner tubular member relative to said outer tubing.

2. In a well cementing tool, an outer tubing; a pair of spaced packers on said tubing adapted to engage a well casing; said outer tubing having an opening in its wall between said packers; means associated with said outer tubing for releasably suspending same from the well casing; an inner tubular member slidably mounted in said outer tubing, said inner tubular member having a port communicating with said opening in said outer tubing; and means in said inner tubular member cooperating with means in said outer tubing for by-passing liquid to opposite sides of said pair of packers when said inner tubular member is in one position relative to said outer tubing and for preventing such by-passing when said inner tubular member is in another position.

3. In a well cementing tool, an outer tubing; a pair of spaced packers on said tubing adapted to engage a well casing; said outer tubing having an opening in its wall between said packers;

means associated with said outer tubing for releasably suspending same from the well casing; an inner tubular member slidably mounted in said outer tubing, said inner tubular member having a port communicating with said opening in said outer tubing; means for by-passing liquid to opposite sides of said pair of packers, said means being closable by movement of said inner tubular member relative to said outer tubing; a shoe mounted on the lower end of said inner tubular member and adapted for supporting said outer tubing on said inner tubular member.

4. In a well cementing tool, an outer tubing; a pair of spaced packers on said tubing adapted to engage a well casing; said outer tubing having an opening in its wall between said packers; means associated with said outer tubing for releasably suspending same from the well casing; an inner tubular member slidably mounted in said outer tubing, said inner tubular member having a port communicating with said opening in said outer tubing; means for by-passing liquid to opposite sides of said pair of packers, said means being closable by movement of said inner tubular member relative to said outer tubing; a shoe mounted on the lower end of said inner tubular member and adapted for supporting said outer tubing on said inner tubular member; and means for temporarily securing the outer tubing and the inner tubular member against relative movement.

5. In a well cementing tool, an outer tubular assembly; a pair of spaced packers mounted on said assembly; said outer tubular assembly having perforate portions above, intermediate of, and below said packers; an inner tubular member slidably mounted in said outer tubular assembly, said inner tubular member having three ports communicating respectively with the perforate portions of the outer assembly when said inner tubular member is in one position relative to said outer assembly, said inner tubular member being movable to prevent communication of the upper and lower ports respectively with the upper and lower perforate portions of the outer assembly while maintaining the intermediate port in communication with the intermediate perforate portion.

6. In a well cementing tool, an outer tubular assembly having a smooth inner wall surface; a pair of spaced packers on said assembly adapted to engage a well casing; said outer tubular assembly having perforate portions above, intermediate of, and below said packers; an inner tubular member having a close sliding fit in said outer tubular assembly, said inner tubular member having three ports communicating respectively with the perforate portions of the assembly when said inner tubular member is in one position relative to said outer assembly, said inner tubular member being movable to prevent communication of the upper and lower ports with the upper and lower perforate portions of the outer assembly while maintaining the intermediate port in communication with the intermediate perforate portion.

7. In a well cementing tool, an outer tubular assembly comprising an outer tubing and a plurality of liners mounted therein forming a smooth cylindrical inner surface; a pair of spaced packers on said tubing adapted to engage a well casing; said outer tubular assembly having perforate portions above, intermediate of, and below said packers; an inner tubular member having a close sliding fit in said outer tubular assem-

bly, said inner tubular member having three ports communicating respectively with the perforate portions of the assembly when said inner tubular member is in one position relative to said outer tubing, said inner tubular member being movable to prevent communication of the upper and lower ports with the upper and lower perforate portions of the outer assembly while maintaining the intermediate port in communication with the intermediate perforate portion.

8. In a well cementing tool, an outer tubular assembly comprising an outer tubing and a plurality of liners mounted therein forming a smooth cylindrical inner surface; a pair of spaced packers on said tubing adapted to engage a well casing; said outer tubular assembly having perforate portions above, intermediate of, and below said packers; an inner tubular member having a close sliding fit in said outer tubular assembly, said inner tubular member having three ports communicating respectively with the perforate portions of the assembly when said inner tubular member is in one position relative to said outer tubing, said inner tubular member being movable to prevent communication of the

upper and lower ports with the upper and lower perforate portions of the outer assembly while maintaining the intermediate port in communication with the intermediate perforate portion; and means for releasably suspending said outer tubular assembly from the well casing.

9. In a well cementing tool, an outer tubing; a pair of spaced packers mounted on said outer tubing; an inner tubular member slidably receivable in said outer tubing and adapted to be suspended on a string of pipe; means establishing communication between the interior of said inner tubular member and the exterior of said outer tubing in the region between said packers; means establishing communication between the interior of said inner tubular member and the exterior of said outer tubular assembly at a point above said packers and at a point below said packers, said inner tubular member being movable to control said last mentioned means and render such communication closed.

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