April 22, 1941. S. R. ROBINSON 2,239,296

CEMENTING TOOL

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Fig. 1.

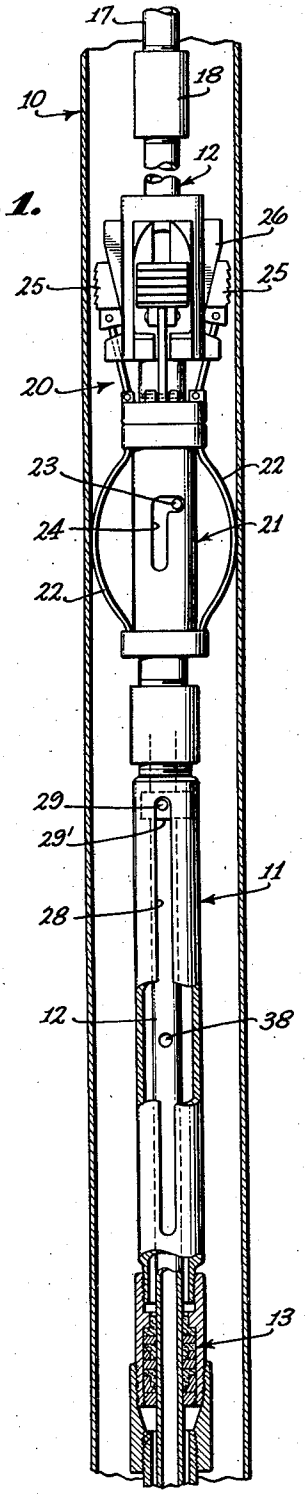
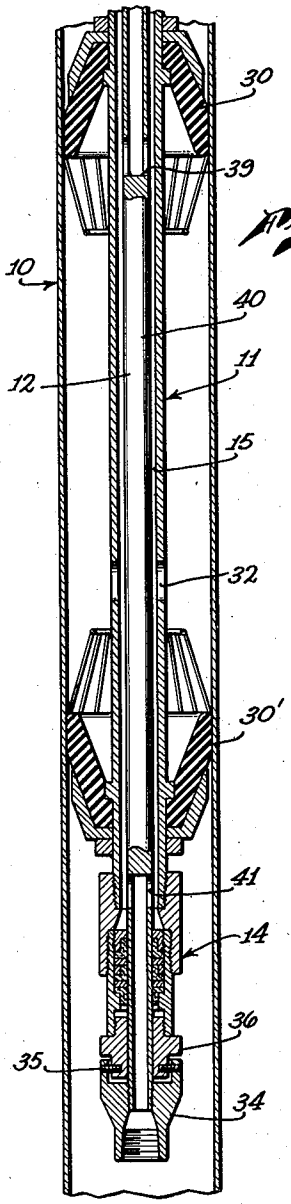


Fig. 1a.



Inventor

SLAYDEN R. ROBINSON,

By Frank Cushman

Attorney

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Fig. 2.

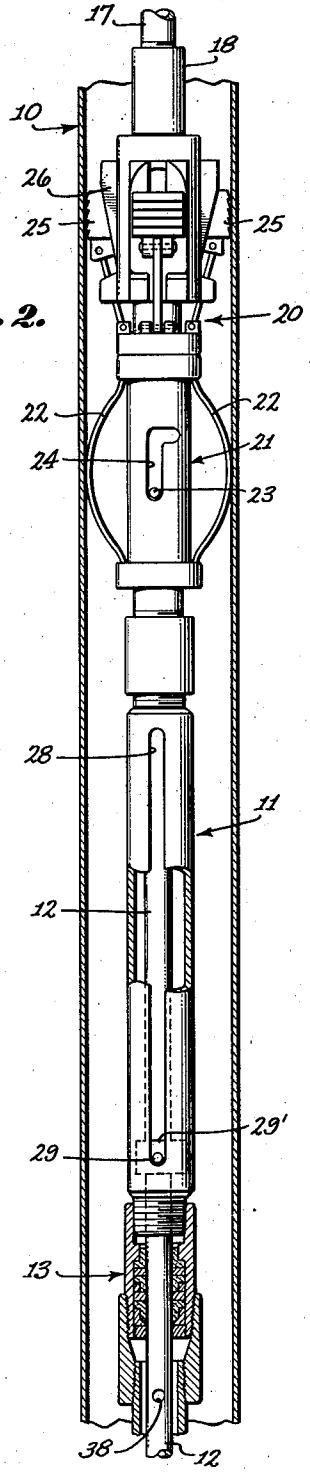
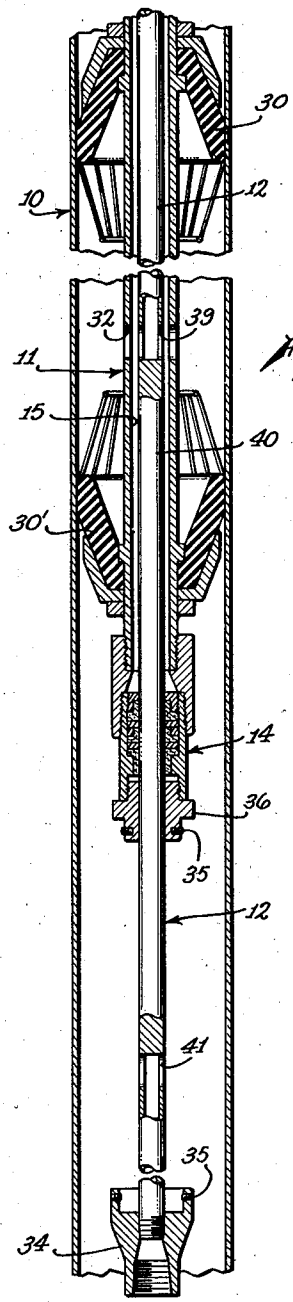


Fig. 2a.



Inventor

SLAYDEN R. ROBINSON,

By Francis Rabuchan

Attorney

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Fig. 3.

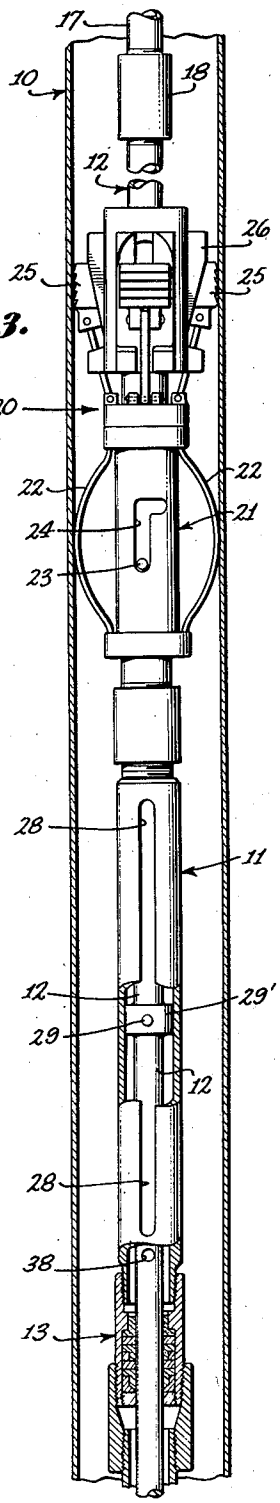
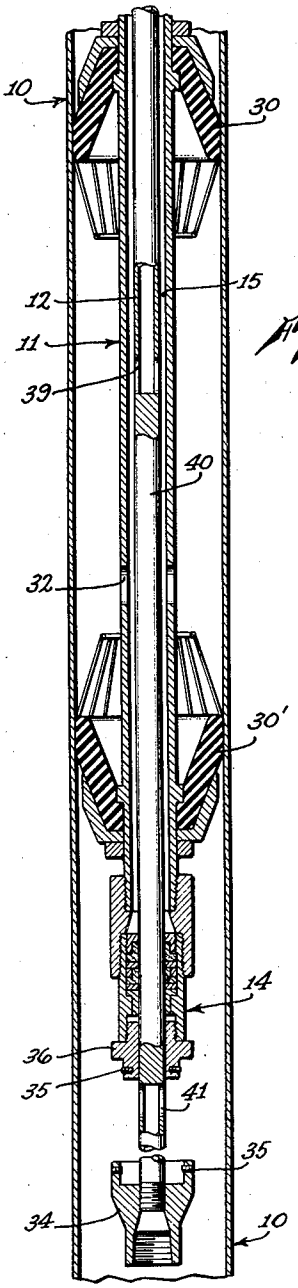


Fig. 3a.



Inventor

SLAYDEN R. ROBINSON,

By Frank Rahmakam

Attorney

Patented Apr. 22, 1941 2,239,296

UNITED STATES PATENT OFFICE

2,239,296

CEMENTING TOOL

Slayden R. Robinson, Whittier, Calif., assignor to Halliburton Oil Well Cementing Company, a corporation of Delaware

Application February 17, 1940, Serial No. 319,547

10 Claims. (Cl. 166—1)

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

In oil well drilling and production practice it is necessary to perform 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, with the apparatus ordinarily used, require considerable time and equipment and necessarily result in leaving apparatus and cement in the well forming objectionable 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.

It is a primary 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 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 well casing.

It is a further object of this invention to provide a tool of the type indicated which may be readily lowered or raised in a well and to accomplish this it is an object to provide the 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. It is also an object to provide a tool in which the by-pass means is closable for the performance of cementing operations and in which the by-pass means is controllable to provide means for flushing the well at a point above the packers on the tool without increasing the pressure of the fluid in the well located below the lowermost packing element of the tool.

It is a still further object to provide a cementing tool which can be readily 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 cementing holes of combination casing.

It is also an object of this invention to provide a tool of simple construction having a minimum of operative parts with relation to the various functions the tool performs.

These and other objects will be apparent from the drawings and the following description thereof. Referring to the drawings which are for illustrative purposes only—

Fig. 1 is a view partly in section of the upper portion of the tool and Fig. 1*a* is a sectional elevation of the remainder of the tool;

Fig. 2 is an elevation partly in section of the upper portion of the tool shown in extended position and Fig. 2*a* is a sectional elevation of the remainder of the tool shown in the extended position;

Fig. 3 is an elevation partly in section of the upper portion of the tool showing the tool in intermediate position and Fig. 3*a* is a sectional elevation of the remainder of the tool also showing the tool in the intermediate position.

More particularly describing the invention, reference numeral 10 indicates a well casing. 11 generally indicates the outer tubing or outer tubular assembly of the tool which is comprised of a plurality of connected units forming an integral outer tubing. Slidably mounted within this tubing 11 is what will be termed an inner tubular member generally indicated by numeral 12. The outer tubing is provided with two stuffing boxes indicated generally by numerals 13 and 14, the stuffing boxes being respectively located at a point intermediate and at the lower end of

the tool. The inner tubular member is slidably receivable in these stuffing boxes and is of a diameter less than the internal diameter of the remainder of the tubing 11 so as to provide an annular space or passageway 15 between the inner tubular member and outer tubing except where such space is interrupted by the stuffing boxes 13 and 14.

The inner tubular member is supported by a string of tubing or drill pipe indicated by numeral 17, a coupling or sleeve 18 being interposed between the upper end of member 12 and the lower end of the string 17. The tool is adapted to be raised and lowered in the well by manipulation of the suspending string 17.

On the upper end of the outer tubing 11 there is provided a conventional slip assembly 20 for anchoring or suspending the outer tubing from the well casing. This slip assembly comprises briefly a slidable sleeve 21 which has casing engaging spring members 22 thereon and which is locked against movement relative to the tubing 11 by means of a pin 23 which engages with an inverted J slot 24 in the sleeve 21. Slight rotation of the member 17 serves to bring the pin 23 in alignment with the major portion of the slot 24 and if the tool is then lowered slightly in the well the sleeve 21 moves upwardly on the tubing and forces the slips 25 to ride upwardly on the slip body 26 to engage the well casing as is known in the art.

Below the slip assembly 20 the outer tubing 11 is provided with an elongated slot 28 in which rides a pin 29 mounted on and extending outwardly from a sub 29' of the inner tubular member 12. The sub provides a convenient means of mounting the pin and serves to radially support the tubular member 12 in the outer tubing 11. The slot and pin construction locks the outer tubing and inner tubular member against relative rotative movement. Below the slotted portion 28 the outer tubing is provided with a pair of spaced packers 30 and 30' and intermediate these packers the tubing is provided with cement ports 32.

The inner tubular member is provided at the lower end with a shoe 34. When the tool is first lowered in the well the outer tubing and inner tubular member are temporarily secured together by means of pins 35 which extend through the shoe and into a bushing 36 located on the lower end of the outer tubing 11. After such pins have been sheared as will be hereinafter described, the outer tubing may be supported upon the inner tubular member through the medium of the shoe 34, as for instance when the tool is raised in the well.

In Figs. 1, 1*a*, the tool is shown in the contracted position. It is in this position that the tool is raised and lowered in the well and in order to facilitate this operation, means are provided in the tool for by-passing fluid in the well to opposite sides of the packers 30, 30'. This means comprises an upper by-pass port 38 which is located in the region of the slot 28 when the tool is in contracted position. The tool is also provided with what will be termed cement ports 39 spaced below the port 38 located between the stuffing boxes 13 and 14. From the cement ports 39 upwardly the inner tubular member is hollow to permit passage of fluid. From that point downwardly the member is solid, down to lower by-pass ports 41, the solid portion being indicated by reference numeral 40. With the tool in the contracted position, the by-pass ports 41 are located above the lowermost stuffing box 14. Below the ports 41, the inner tubular member 12 is hollow so that fluid may pass from that point downwardly and out therethrough to a point external of the tool below the shoe 34.

Thus with the tool in the contracted position of Figs. 1, 1*a*, fluid in the well may by-pass, assuming the tool is being lowered in the well, upwardly through the lower tubular portion of the inner tubular member, through ports 41 into the space 15 between the inner tubular member and the outer tubing and upwardly and into ports 39, up through the inner tubular member past the stuffing box 13 and out through ports 38 and slot 28 to a point above the uppermost packer 30. If the tool is being raised the flow of fluid is in the reverse direction through the above described communicating passages.

Although the inner tubular member has been shown and described as being solid between ports 39 and 41, the member might be made tubular in this region and a barrier means provided to prevent flow of fluid through the member from ports 39 to 41.

In order to perform a cementing operation the tool is lowered in the well in the contracted position of Figs. 1, 1*a* and at approximately the desired point the string 17 is rotated to bring the pin 23 and the slip assembly into alignment with the major portion of the slot 24 to permit setting of the slips. Jarring of the inner tubular member then serves to shear the pins 35 and permit relative movement of the inner tubular member with respect to the outer tubing. The inner tubular member is then lowered, the outer tubing being suspended by means of the slips from the well casing. With the inner tubular member in its lowermost position as illustrated in Figs. 2, 2*a*, the upper by-pass ports 38 are brought to a position below the stuffing box 13 while at the same time the cementing ports 39 are brought to a position opposite the cement outlets 32. Simultaneously, the lower by-pass ports 41 are brought to a position below the stuffing box 14. In this position it is apparent that liquid circulated down through the string 17 and inner tubular member 12 can only escape from the tool through the ports 38 and 39 out through cement ports 32 between the packers 30—30'. With the tool in this position, it is easy to determine whether the portion of the tool between the spaced packers is in a region of perforated or non-perforated casing for the reason that circulated liquid will not be able to escape from the space between the packers unless there are perforations in the casing. In this connection it should be noted that the concave sides of the packers are positioned facing each other so that when the pressure is increased between the packers it will tend to cause them to more firmly engage the well casing to prevent escape of fluid from the region between the packers along the inside of the casing. If circulation down through the tool is impeded as will become apparent from the jump in pump pressure the tool may be raised slightly and circulation again started to determine whether the tool is in the region of perforated casing such as with the packers on opposite sides of a combination point hole.

After the tool has been properly located in the well and preliminary circulation of fluid established, the cementing operation may be performed by forcing cement slurry under pressure down the string 17. It is preferable at first to have the tool in the position of either Figs. 2,

2a or Figs. 3, 3a so that the liquid in the string 17 below the introduced cement will be forced out of the by-pass openings rather than between the packers. Thus the objectionable displacement of liquid through the well casing into the region where it is desired to cement is prevented. After the known quantity of liquid in the string 17 below the introduced cement has been circulated out and the cement has been pumped down to the tool, the tool may be adjusted to the extended position of Figs. 2, 2a and the cement will be forced out of ports 39—32 to the region between the packers and then out through the perforations or holes in the casing with continued pumping. After the cementing operation has been performed, the tool may be raised and excess cement may be circulated from the casing between the tool and the casing by circulating fluid downwardly between the casing and the tool with the tool in the extended position of Figs. 2, 2a, the liquid passing the upper packer and entering the tool through the cement outlet 32 and ports 39. This will serve to clean the space between the packers of cement and will also serve to flush out the interior of the tool.

By raising the inner tubular member to a point intermediate that of Figs. 1, 1a; 2, 2a; such position being illustrated in Figs. 3, 3a, it is possible to circulate liquid as above outlined and part of the circulated fluid will enter through the slot 28 and into the upper by-pass port 38. With the tool in such position very little of the fluid will pass the upper packer and enter the tubing through the port 32. It is often preferable to perform this flushing operation in place of the one first described. With the tool in the intermediate position, it is also possible to establish circulation down through the string 17 and the inner tubular member and out through the upper by-pass ports 38 and slot 28 to a point external of the tool. By this operation the tool may be cleaned to the point of the by-pass ports 38 and the region between the casing and the tool above the upper packing may be flushed out.

It is to be noted that in any of the flushing or cleaning operations wherein liquid is circulated through the tool in either direction that with the tool in the position of either Figs. 2, 2a or 3, 3a, no pressure is put on the column of liquid in the well below the lower packer 30' by reason of the fact that the lower by-pass ports 41 are located below the lowermost stuffing box 14 thereby precluding any possibility of circulation of fluid either into or out of the lower end of the outer tubing.

If desired, it is also possible to circulate fluid through the tool in either direction with the tool in the position of Figs. 1, 1a.

Although the invention has been particularly shown and a particular method of use described, it is to be understood that it is not intended to limit the invention to the exact construction shown and described or the uses suggested, but it is intended to cover such changes as come within the scope of the claims.

I claim as my invention:

1. In a cementing tool, an outer tubing; an inner tubular member slidably mounted in said tubing; spaced inner packing means in said tubing engaging said inner tubular member at two spaced points, said tubing and inner tubular member cooperating to provide fluid passage space between said members interrupted by said packing means; said tubing having an opening in its wall above the upper packing means and another opening intermediate the spaced packing means; a pair of spaced outer packer members mounted on said tubing on opposite sides of the lowermost opening in the wall of said tubing; said inner tubular member having an upper, an intermediate, and a lower port; barrier means in said inner tubular member between the intermediate and lower ports preventing flow of fluid through said member from end to end; said inner tubular member being positionable in said outer tubing to locate said upper port above the upper of said packing means and to locate the other two ports between said inner packing means.

2. In a cementing tool, the combination as defined in claim 1 in which the inner tubular member is movable to locate said upper port between said spaced inner packing means and to locate said lower port below the lowermost inner packing means while maintaining the intermediate port between the spaced inner packing means.

3. In a cementing tool, the combination as defined in claim 1 in which the inner tubular member is movable to locate said lower port below the lowermost inner packing means while maintaining the upper port above the uppermost inner packing means and while maintaining the intermediate port between the spaced inner packing means.

4. In a cementing tool, an outer tubing; an inner tubular member slidably mounted in said tubing; spaced inner packing means in said tubing engaging said inner tubular member at two spaced points; said tubing and inner tubular member cooperating to provide fluid passage space between said members interrupted by said packing means; said tubing having an opening in its wall above the upper packing means and another opening intermediate the packing means; a pair of spaced outer packer members mounted on said tubing on opposite sides of the lowermost opening in the wall of said tubing; said inner tubular member having an upper, an intermediate, and a lower port; barrier means in said inner tubular member between the intermediate and lower ports preventing flow of fluid through said member from end to end; said inner tubular member being positionable in said outer tubing to locate said upper port above the upper of said packing means and to locate the other two ports between said spaced inner packing means; means for suspending said outer tubing from the well casing; and means for limiting movement of said inner tubular member in said outer tubing.

5. In a cementing tool, an outer tubing; an inner tubular member slidably mounted in said tubing; spaced inner packing means in said tubing engaging said inner tubular member at two spaced points; said tubing and inner tubular member cooperating to provide fluid passage space between said members interrupted by said packing means; said tubing having an opening in its wall above the upper packing means and another opening intermediate the spaced packing means; a pair of spaced outer packer members mounted on said tubing on opposite sides of the lowermost opening in the wall of said tubing; said inner tubular member having an upper, an intermediate, and a lower port; barrier means in said inner tubular member between the intermediate and lower ports preventing flow of fluid through said member from end to end; said inner tubular member being positionable in said

outer tubing to locate said upper port above the upper of said packing means and to locate the other two ports between said spaced inner packing means; means for suspending said outer tubing from the well casing; means for limiting movement of said inner tubular member in said outer tubing; and means for temporarily securing said outer tubing and inner tubular member against relative movement.

6. A cementing tool comprising an outer tubing; an upper stuffing box mounted in said tubing; a lower stuffing box mounted in said tubing in spaced relation to said upper stuffing box; an inner tubular member in said outer tubing slidably receivable in said stuffing boxes; said tubing and inner tubular member cooperating to provide fluid passage space between said members interrupted by said stuffing boxes; said tubing having an opening in its wall above the upper stuffing box and another opening intermediate the upper and lower stuffing boxes; a pair of spaced packer members mounted on said tubing on opposite sides of the lowermost opening in the wall of said tubing; said inner tubular member having an upper, an intermediate and a lower port; said inner tubular member being provided with a solid portion between the intermediate and lower ports; said inner tubular member being positionable in said outer tubing to locate said upper port above the upper stuffing box and to locate the other two ports between said spaced inner packing means.

7. A cementing tool as defined in claim 6 in which the inner tubular member is movable to locate said upper port between said stuffing boxes and to locate said lower port below the lower stuffing box while maintaining the intermediate port between said stuffing boxes.

8. A cementing tool as defined in claim 6 in which the inner tubular member is movable to locate said lower port below the lower stuffing box while maintaining the upper port above the upper stuffing box and while maintaining the intermediate port between the spaced stuffing boxes.

9. A cementing tool comprising an outer tubing; an upper stuffing box mounted in said tubing; a lower stuffing box mounted in said tubing in spaced relation to said upper stuffing box; an inner tubular member in said outer tubing slidably receivable in said stuffing boxes; said inner tubular member being adapted for connection to a string of tubing for suspension in a well; said tubing and inner tubular member cooperating to provide fluid passage space between said members interrupted by said stuffing boxes; said tubing having an opening in its wall above the upper stuffing box and another opening intermediate the upper and lower stuffing boxes; a pair of spaced packer members mounted on said tubing on opposite sides of the lowermost opening in the wall of said tubing; said inner tubular member having an upper, an intermediate and a lower port; said inner tubular member being provided with a barrier between the intermediate and lower ports; said inner tubular member being positionable in said outer tubing to locate said upper port above the upper stuffing box and to locate the other two ports between said spaced inner packing means; means for releasably suspending said outer tubing from the well casing; and means for limiting movement of said inner tubular member in said tubing.

10. A cementing tool comprising an outer tubing; an upper stuffing box mounted in said tubing; a lower stuffing box mounted in said tubing in spaced relation to said upper stuffing box; an inner tubular member in said outer tubing slidably receivable in said stuffing boxes, said inner tubular member being adapted for connection to a string of tubing for suspension in a well; said tubing and inner tubular member cooperating to provide fluid passage space between said members interrupted by said stuffing boxes; said tubing having an opening in its wall above the upper stuffing box and another opening intermediate the upper and lower stuffing boxes; a pair of spaced packer members mounted on said tubing on opposite sides of the lowermost opening in the wall of said tubing; said inner tubular member having an upper, an intermediate and a lower port; said inner tubular member being provided with a barrier between the intermediate and lower ports; said inner tubular member being positionable in said outer tubing to locate said upper port above the upper stuffing box and to locate the other two ports between said inner packing means; and means for temporarily securing said outer tubing and inner tubular member against relative movement.

SLAYDEN R. ROBINSON.