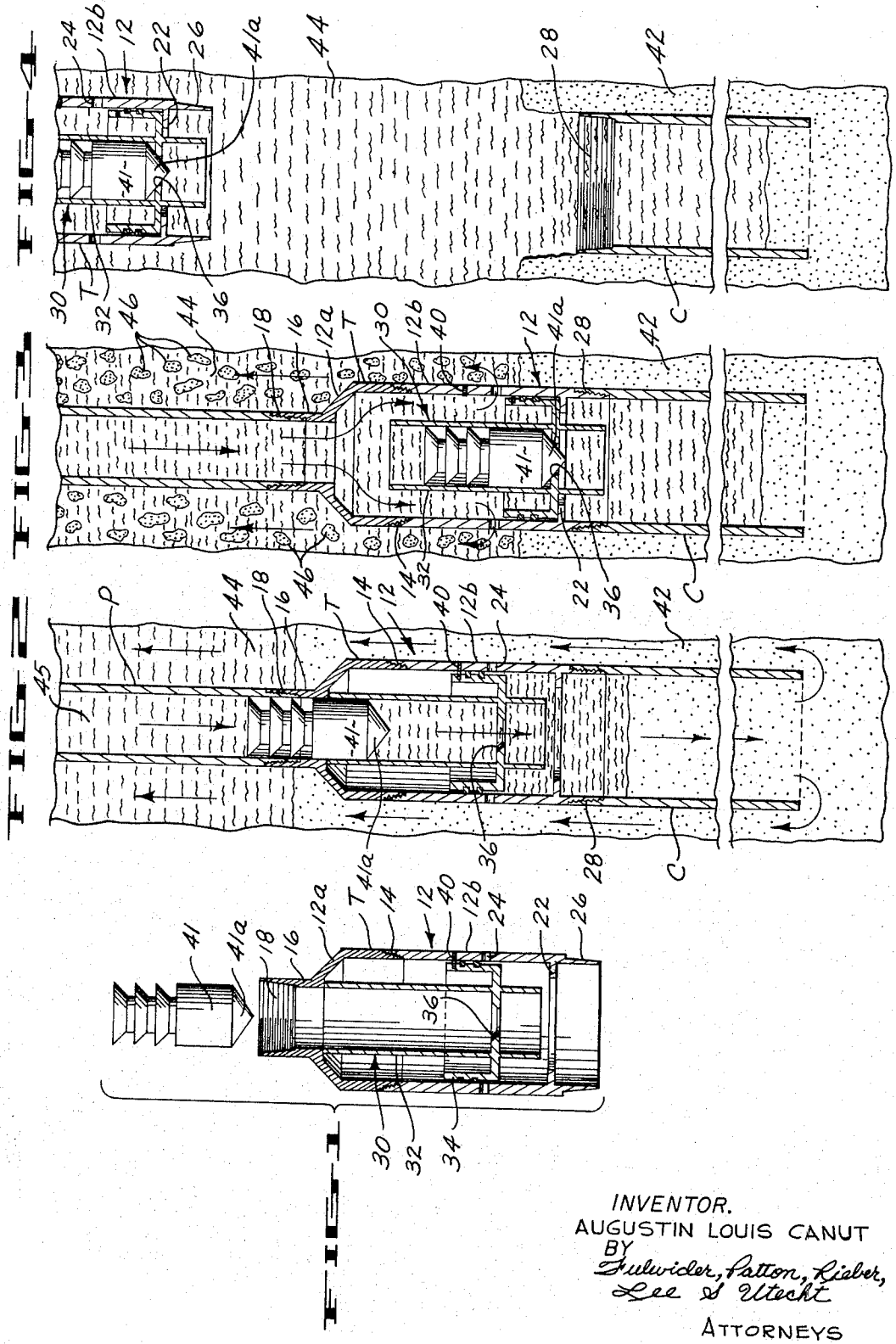
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WELL CEMENTING METHOD

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WELL CEMENTING METHOD

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ABSTRACT OF THE DISCLOSURE

A method of cementing casing within the annulus of a portion of a well bore by first lowering the casing at the bottom of a pipe string. Cement is then forced down the pipe string and casing until it rises upwardly within the annulus above the casing. Openings are then unblocked between the lower portion of the pipe string and the annulus above the openings while flow through the pipe string below the openings is blocked. Liquid is pumped under pressure through the pipe string and out the openings to break-up the unhardened cement and lift it to the surface. Finally, the upper end of the casing is disconnected from the pipe string below the point where it was blocked and the pipe string is lifted to the surface leaving the well bore unobstructed.

The present invention relates to a method to be employed in the cementing of casing in the bore hole of a well.

In cementing casing in well bores various methods and apparatus are conventionally employed. Ordinarily, the cement slurry is introduced into the annulus between the outer wall of the casing and the walls of the bore hole by pumping it from the surface down through the pipe supporting the casing and the casing itself. This cement blows out through the bottom of the casing, from which point the cement flows through the annulus up and around the casing. The cement is then permitted to harden. The portion of the casing adjacent the producing formation is then removed as by milling or cutting, involving considerable time and expense. In addition, the oil producing formation is subject to contamination by the cement filtrate as the latter "sets up." Moreover, it sometimes occurs that the casing-supporting pipe string becomes stuck in the well bore by the cement as the latter hardens. The removal of such stuck pipe is time-consuming and costly.

The present invention relates to a novel method of cementing casing within the annulus of a portion of a well bore without the necessity of milling or cutting either the casing or the cement.

It is another object of the present invention to provide a well cementing method which eliminates exposing the producing formation to contamination by the cement filtrate.

A further object of the present invention is to provide a well cementing method which eliminates the danger of the casing-supporting pipe string becoming stuck in the hole as cement hardens.

A more particular object of the present invention is to provide a method of cementing casing within the annulus of a well bore that includes lowering the casing into the well bore at the bottom of a pipe string, forcing cement down the interior of the pipe string and casing until the cement rises upwardly within the bore annulus to a point above the casing, then providing an opening between the interior of the lower portion of the pipe string and the annulus above the casing while blocking liquid flow below such opening. Before the cement hardens liquid is forced downwardly under pressure through the pipe string and outwardly through the aforementioned opening to thereby break up the unhardened cement in the annulus above the casing, with such broken cement being lifted upwardly through the annulus by the liquid to the earth's surface.

These and other objects and advantages of the present invention will become apparent from the following detailed description, when taken in conjunction with the appended drawings wherein:

FIGURE 1 is a central vertical view showing a tool that may be utilized in the method of the present invention;

FIGURE 2 is a central vertical sectional view showing a first step in said method;

FIGURE 3 is a view similar to FIGURE 2 showing a second step of said method; and

FIGURE 4 is a view similar to FIGURES 2 ad 3 showing a final step in said method.

Referring to the drawings there is shown in a tool T which may be utilized in the method of the present invention. This tool T is adapted to be secured to the lower end of a pipe string P so as to define a downward continuation of the pipe string. The upper end of the pipe string P extends to the earth's surface. The lower end of the tool T is removably connected to the upper end of a length of casing C which is to be cemented within the well bore **11**. After the casing C has been cemented in the well bore the pipe string P including the tool T is disconnected from the well bore **11** as indicated in FIGURE 4, leaving casing C cemented within the well bore.

More particularly, the tool T includes a generally tubular body, generally designated **12**. The body **12** includes an upper section **12***a* that is threadedly secured at its lower end to a lower body section **12***b* at a threaded joint **14**. The upper end of upper body section **12***a* is provided with an integral neck **16** formed with internal right-hand threads **18** that fit the conventional external threads formed on the lower end of the drill pipe F.

The lower body portion **12***b* has an open lower end. The interior of the lower portion of the body member **12***b* is formed with a radially inwardly extending circumferential stop **22**. A plurality of ports **24** are formed through the intermediate portion lower body section **12***b*. The lower end of body section **12***b* is formed with external left-hand threads **26** that fit the threads **28** formed at the upper end of casing C.

Disposed within the body **12** is a piston member, generally designated **30**. The piston member includes a sleeve **32** coaxially with body **12**. The inner diameter of the sleeve **32** generally corresponds to the inner diameter of the drill pipe P. The lower portion of the sleeve **32** is formed with a piston **34** that is slidable within the lower body section **12***b*. The midportion of the piston **34** is formed with a coaxial seat **36**. The piston **34** is normally retained in its position shown in FIGURES 1 and 2 by means of one or more shear pins **40**.

The body **12** is adapted to receive a plug **41** when the latter is urged downwardly through the pipe string P. The plug **41** has an outside diameter somewhat less than the inside diameter of body neck **16** and sleeve **32**. The lower end of the plug **41** is formed with a pointed nose **41***a* that seats within the seat **36** of the piston member **30**, as indicated particularly in FIGURE 3.

In the operation of the method of the present invention, the aforedescribed tool T is interposed between the upper end of the casing C and the pipe string P. These elements are run into the well bore until the casing C is disposed at the desired elevation. At this time the plug **41** is not in place within the body **12**.

Next, cement slurry **42** is pumped downwardly through the pipe string P and flows through tool T and casing C until it rises upwardly through the annulus **44** of the well bore to a point adjacent the upper portion of the

tool T, as indicated in FIGURE 2. During this step the ports 24 will be closed by the skirt of piston 34. The well bore and pipe string P are filled with mud 45 above the cement 42 at this time.

Before the cement 42 hardens the plug 41 is dropped through the pipe string P and its nose portion 41*a* sealingly engages the seat 36 of piston 34. Mud pressure is increased until the downward force applied by the mud 45 against the upwardly-facing surface area of the piston 34 causes the shear pin 40 to break. The piston 34 and plug 41 will then move downwardly until the piston engages the piston stop 22, as indicated in FIGURE 3.

With continued reference to FIGURE 3, such downward movement of the piston member 34 serves to open the ports 24 whereby communication is obtained between the interior of the pipe string P and the annulus 44. The outwardly flowing mud passes through ports 24 and breaks up the unhardened cement adjacent and above the ports. The cement particles 46 will then be lifted upwardly to the earth's surface by the mud 45.

When the cement 42 has hardened sufficiently, the pipe string P will be rotated so as to disengage the threads 26 of the tool T from the threads 28 of the casing C. The pipe string and tool T are then withdrawn upwardly through the well bore, as indicated in FIGURE 4 leaving the casing C cemented in place. The tool T may be readied for reuse by unscrewing the upper body section 12*a* from the lower body section 12*b* thereof to effect cleaning of the interior of the tool. After such cleaning the shear pin 40 will be replaced.

It should be noted that the aforedescribed method may be utilized in both uncased and cased well bores. It should also be noted that various modifications and changes may be made with respect to the foregoing detailed description without departing from the spirit of the present invention or the scope of the following claim.

I claim:

1. The method of cementing casing within the annulus of a portion of a well bore, comprising:

lowering said casing into said well bore portion at the bottom of a pipe string;

forcing cement down the interior of said pipe string and casing until said cement rises upwardly within the bore annulus from the bottom of said bore portion to a point above said casing;

providing a plurality of circumferential openings between the interior of the lower portion of said pipe string and said annulus immediately above said casing;

plugging said pipe string to liquid flow below said openings;

forcing liquid downwardly under pressure through said pipe string, said liquid moving outwardly through said openings to break up the cement in said annulus above said casing, said broken cement being lifted upwardly through said annulus by said liquid;

disconnecting the upper end of said casing from said pipe string below the point at which said pipe string was plugged; and lifting said pipe string from said well bore leaving said casing unobstructed.

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