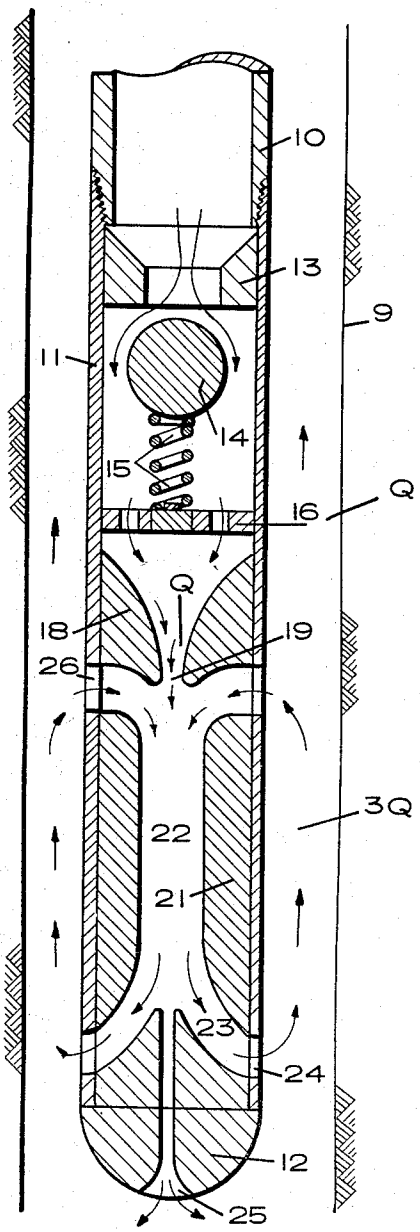
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WELL CEMENTING DEVICE WITH JET RECYCLING

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WELL CEMENTING DEVICE WITH JET RECYCLING

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This invention concerns an improved method and apparatus applicable to the practice of cementing casings and liners and similar tubular members in well bores. More particularly the invention relates to improvements in the displacement of drilling mud from the bore hole annulus adjacent a casing within a well bore whereby a more efficient cement job can be obtained.

In the course of drilling and completing an oil well it is common practice to insert one or more strings of casing into the well and to cement selected sections of the casing in place in order to prevent undesirable fluids such as water from entering the producing formation from other strata above or below the producing formation. The most common practice for cementing casing in the well consists in circulating a quantity of cement down through the casing and out into the annulus behind the casing where the cement is then allowed to set. One of the serious problems encountered in oil well cementing is that of obtaining effective displacement of drilling mud by cement so as to produce a reliable fluid-tight seal. To solve this problem there has been developed a so-called jetting shoe which directs the cement slurry out through the orifices in the shoe to impinge against the walls of the bore hole and thereby remove the mud cake. However such equipment still leaves much to be desired in the way of efficient displacement of all of the drilling mud from the annulus and from the borehole walls. It is generally recognized that the most important section of a string of casing to be cemented in a well is the lower 20 or 30 feet. If suitable means can be provided that will efficiently mix or displace all of the mud in this section of the well with cement the chances are very great that a reliable cementing operation will result.

It is an object of the present invention to provide a cementing method and a device that will ensure the efficient displacement of all of the drilling mud from the walls of the bore hole adjacent the lower end of the casing and the efficient mixing of the mud with cement so as to obtain a homogeneous mixture that will result in a better cementing operation.

In accordance with the present invention an efficient flushing and mixing action is provided by means of a special casing section having a nozzle assembly that exerts an aspirating effect which will cause a portion of the stream of cement rising in the annulus at the lower end of the casing to be recycled back through the special casing section to mix with fresh cement passing down through the casing.

The nature and objects of this invention will be readily appreciated when reference is made to the accompanying drawing in which the single figure depicts, in sectional elevation, the special casing section of this invention in position in a bore hole.

Referring to the figure in particular, a special casing section **11** is shown in position in the bore hole **9**. Casing section **11** is adapted to be attached to the lower end of conventional casing **10** by means of the threads provided. Attached to the lower end of the casing section is a conventional cementing shoe **12**. Also positioned within the upper portion of the special casing section is a conventional cementing float valve assembly comprising a valve seat **13** and a float valve **14** which is normally urged against the seat by means of spring **15** held by support member **16**. As in conventional cementing equipment the flow valve assembly is constructed of a drillable material, such as a magnesium or aluminum alloy, or similar material.

Positioned within the lower portion of the casing section **11** is a nozzle assembly that constitutes the improvement provided by the present invention. A primary nozzle body **18** having a nozzle opening **19** and a secondary nozzle body **21** providing a central nozzle or passageway **22**, which may also be designated a mixing chamber, constitute two elements of the nozzle assembly. It will be noted that the second nozzle body is positioned a spaced distance below the first nozzle body and at least one port **26** is provided in the wall of the casing **11** in the area between the two nozzle bodies.

The lower end of the second nozzle body **21** flares outwardly and is positioned a fixed distance above the top of the shoe member **12** which has an upper contour matching that of the lower end of the second nozzle body so as to define a chamber **23** therebetween. At least one port **24** is provided in the wall of the casing member **11** to furnish fluid access between chamber **23** and the bore hole annulus. Nozzle body members **18** and **21** as well as shoe **12** are constructed of drillable material such as a magnesium or aluminum alloy, a phenolic plastic, a concrete aggregate or the like so that when the cementing operation has been completed the inside of the casing may be drilled out as in conventional cementing practice.

In utilizing the device of this invention it is attached to the lower end of a string of casing and floated into place as in conventional cementing practice. Then a quantity of cement is circulated down through the casing past the conventional float valve, through the primary nozzle opening **19** into the mixing chamber **22**, out through the side ports **24** and the cementing shoe port **25** and up through the bore hole annulus. In passing through the primary nozzle opening **19** the stream of cement is converted into a high velocity jetted stream of fluid. In other words the nozzle by providing a substantial pressure drop converts the fluid pumping pressure exerted on the cement into velocity energy. The jetted stream of cement in passing from the primary nozzle opening into the secondary nozzle or mixing chamber **22** creates an aspirating effect in the vicinity of ports **26** so that fluid is drawn in through ports **26** from the bore hole annulus. Thus in effect the nozzle assembly serves as a jet pump. The nozzle assembly may be so designed that for each volume of fluid that passes down through the primary nozzle two volumes of fluid will be drawn in through the aspirating ports **26**. Thus for a given quantity of fluid Q being pumped down through the casing three times this volume of fluid, i. e. three times Q will flow up the bore hole annulus in the region between the cementing shoe and the aspirating ports **26**. It will thus be seen that the fluid moving up this portion of the annulus will be travelling at a high velocity which will ensure that the mud cake clinging to the walls of the bore hole will be efficiently removed therefrom. Also in view of the aspirating and mixing effect a considerable quantity of cement and drilling mud will be recycled through the assembly a large number of times for a given quantity of cement that is pumped down through the casing. Thus by the time all of the cement has been placed in position a homogeneous mixture of cement and residual mud will have been obtained so that when the cement sets up a fluid tight seal will be obtained.

It is to be understood that the specific embodiments of the invention described herein are by way of example and that the invention is not to be limited thereto. The true scope of the invention is defined by the appended claims.

What is claimed is:

1. A device for improving the operation of cementing casing into position in a well bore comprising a casing section, a first nozzle body positioned within the casing section and providing therein a downwardly directed fluid jet nozzle, and a second nozzle body positioned within the said casing section a spaced distance below said first nozzle body and providing within the casing a second nozzle passageway in general alignment with said first nozzle, said casing section having at least one side port between the first and second nozzle bodies and at

least one opening below the second nozzle passageway and communicating therewith.

2. A device as defined by claim 1 including a cementing shoe on the lower end of the casing section and at least one side port in the casing section above the said shoe, said last named port communicating with the lower termination of said second nozzle passageway.

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