New Casing Cementing Methods

Abstract

A new method of cementing casing into a water well is presented. This method allows the well to be drilled to full depth and even be fully developed prior to cementing without endangering the producing zone and yet still ensuring a high quality cement job. It is applicable to all commonly used casing materials and any screen type or no screens at all. Furthermore, all operations are performed in a single run of tools into the well.

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Introduction

Normally when drilling a water bore, after setting surface casing, you'd drill ahead for your casing to just above the aquifer level, run and cement the casing using a float shoe or similar and then drill out the float shoe through the casing and continue on into the producing zone. If setting a screen you'd then run a telescopic screen sealed back to casing with a packer and start developing.

This system works well as it achieves the primary objective of accessing the producing zone without compromising the integrity of upper formations. It has stood the test of time. However, it does require more trips in and out of the bore than most would like. Through the use of inflatable packers, a number of new casing cementing methods now provide more efficient ways of achieving the same objectives.

Each of these offers a single shot screen & casing running and cementing operation. They are shown in summary on Figure 1 attached. All offer the following advantages:

- The bore may be drilled to TD in a single run at a single size;
- Casing and screen are run in-line in a single operation;
- The casing is cemented in one operation;
- The aquifer is fully sealed against cement contamination by an inflatable packer.

The systems presented in more detail in the following offer a single shot process for shallow, medium and deep bores respectively.

Shallow Bores

Figure 1(c) shows a system suitable for one shot casing and screen installation and grouting in a shallow bore. The basics of the system are:

1. After setting surface casing, drill the bore to TD at a single diameter.
2. Run the casing and the screen in-line with an inflatable packer installed on the casing just above the connection to the screen.

3. Inflate the packer from the surface using the inflation tube that is run in the casing/hole annulus.
4. Grout fill the casing/hole annulus using the tremie pipe that was run in the annulus while installing the casing.

Since the inflatable packer positively seals the aquifer from contamination, borehole development can start immediately after placement of the grout.

This system provides a very time efficient method of installing and cementing casing with or without an in-line screen in shallow bores. For deeper bores one of the following methods may be more appropriate.

Medium Depth Bores

Figure 2 shows the steps involved in the installation of in-line casing and screen in a medium depth bore. As can be seen, the surface casing, drilling and casing/screen running proceeds as for shallow bores except that no grout tremie pipe is run in the annulus. The casing packer is also inflated from the surface using a small bore tube run in the annulus as previously. Only the method of grout placement differs.

In this system, a sleeve type grouting valve is provided in the casing just above the packer. The valve basically consists of a rubber sleeve covering a series of radial holes in the casing. It acts as a check valve, allowing flow out into the annulus but preventing return flow.

The grouting valve is addressed by a straddle packer system that is run into the casing on a separate grouting string to locate the packers either side of the valve. These packers are inflated from the surface, again using a small bore tube, which isolates the valve. Cement grout is then pumped into the annulus from the grout string via the packer isolated valve.

To avoid cement contamination of the inside of the casing, dual inflation tubes are usually run for the straddle packers. Thus the top packer can be deflated to allow flushing of the string and straddle zone while the lower packer remains inflated to protect the producing zone. Other alternatives are over-displacing the cement with water or using a wiper plug to clear the grouting string. In any case, as soon as the cement is cleared from inside the casing, the packers can both be deflated and tripped out to allow starting of development procedures.

This system is applicable to wells of medium depth say 150 to 200 metres depending on ground conditions. For deeper bores, the following system is more appropriate.

Deep Boreholes

In a deep bore, say 200 metres or more, it is often impractical to run a packer inflation tube in the casing/hole annulus. This situation is addressed by the third one shot system shown in some detail on Figure 3.
Installation up to the point where the casing/screen has been run into the bore is the same as the previous systems. The difference being that the grout valve mounted above the packer on the casing is also configured to enable inflation of the packer through this and two in-line check valves. A second difference occurs in the valve isolation tool where a mechanical pack-off is

employed in place of the straddle packers used in the medium depth system. This tool seals in a reduced bore section adjacent to the packer/valve assembly. The diameter reduction required is small and usually coincides with the smaller screen diameter in any case.

After running the tool in on a suitable drill string, pumping clean water through the string will inflate the casing packer. When the preset maximum inflation pressure is reached, the valve shears open to allow circulation into the annulus above the packer. (Packer inflation pressure is retained via a dual check valve assembly.) With the valve open cement grout is then pumped into the annulus.

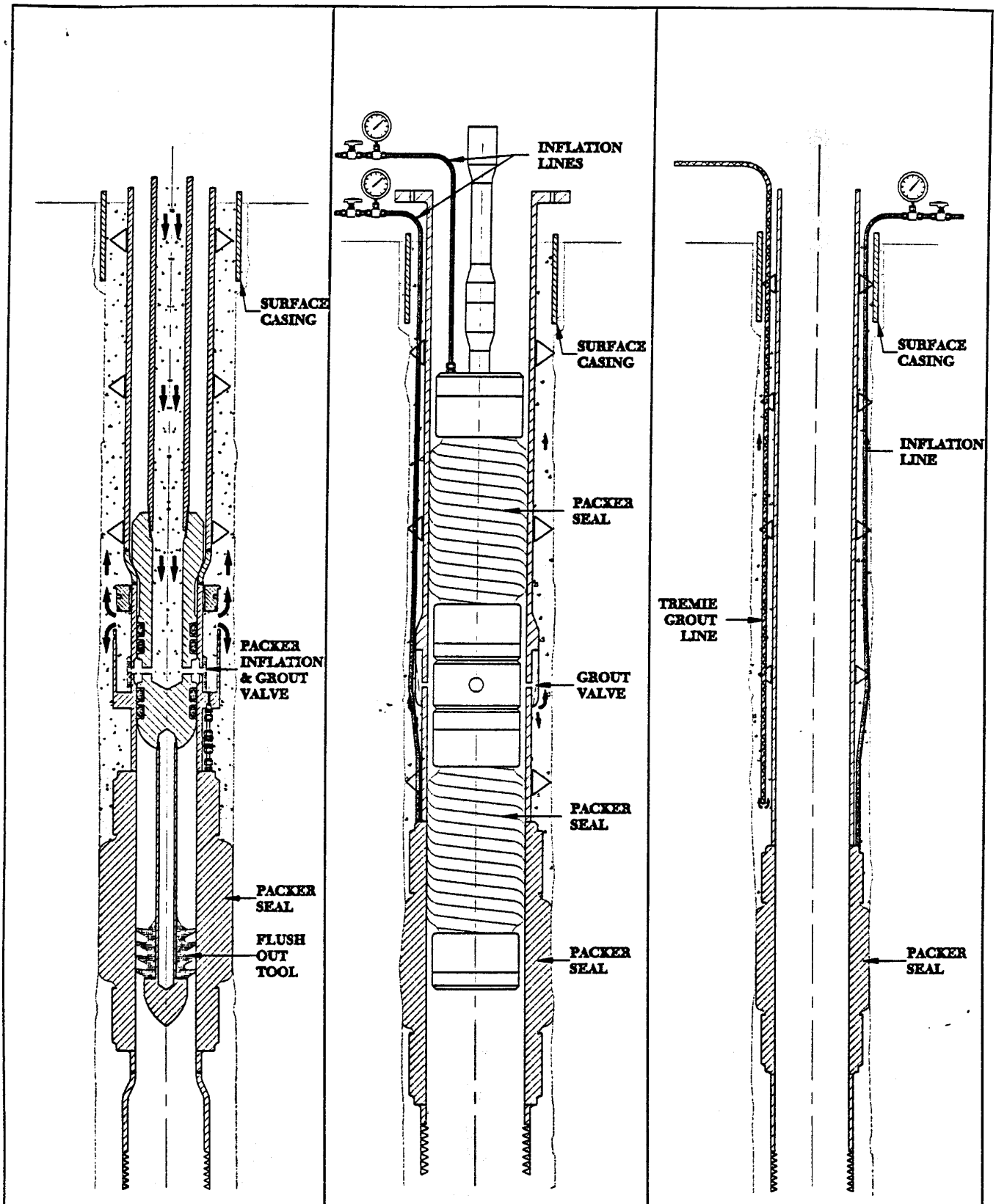
To clear cement from the string the options of over-displacing or pumping a wiper can be employed. Another option is provided by the wiper style extension on the stab-in tool. This allows the tool to be raised clear of the grout valve for flushing of the string and casing while the wiper section continues to seal the lower portion of the casing against contamination.

Conclusions

Three methods of casing/screen installation have been presented. Each employs an inflatable packer mounted in the casing string to isolate the aquifer region from the region to be grouted. Each offers significant advantages over the traditional float shoe grouting method including:

- Fewer pipe trips into and out of the bore hole;
- Casing with an in-line screen may be run and cemented in a single operation;
- Well development can proceed immediately after cementing without waiting on the cement to cure;
- Wells can be completed with a single drill diameter.

These processes, although employed on many projects already, are yet to become standard practice in the water well drilling industry. It seems likely that they will become so owing to their inherent efficiency and overall cost effectiveness.



OPEN HOLE ONE SHOT COMPLETION STAB-IN INFLATION

(A) DEEP BORES

OPEN HOLE ONE SHOT COMPLETION 50-200m WITH INFLATION HOSE

(B) MEDIUM BORES

OPEN HOLE SHALLOW WELLS

(C) SHALLOW BORES

FIGURE 1 - ONE SHOT SCREEN & CASING INSTALLATION SYSTEMS

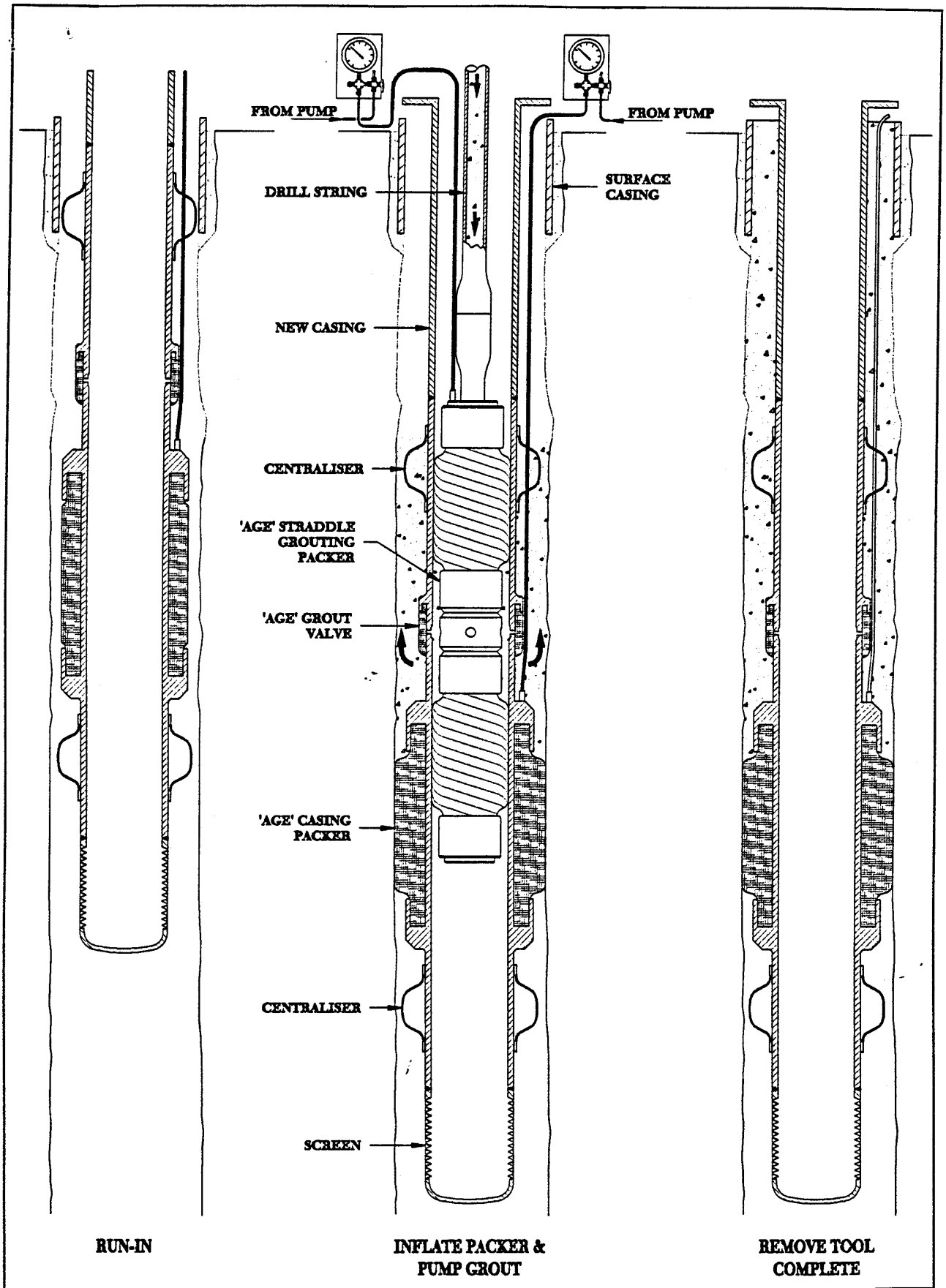


FIGURE 2 - MEDIUM DEPTH BORES

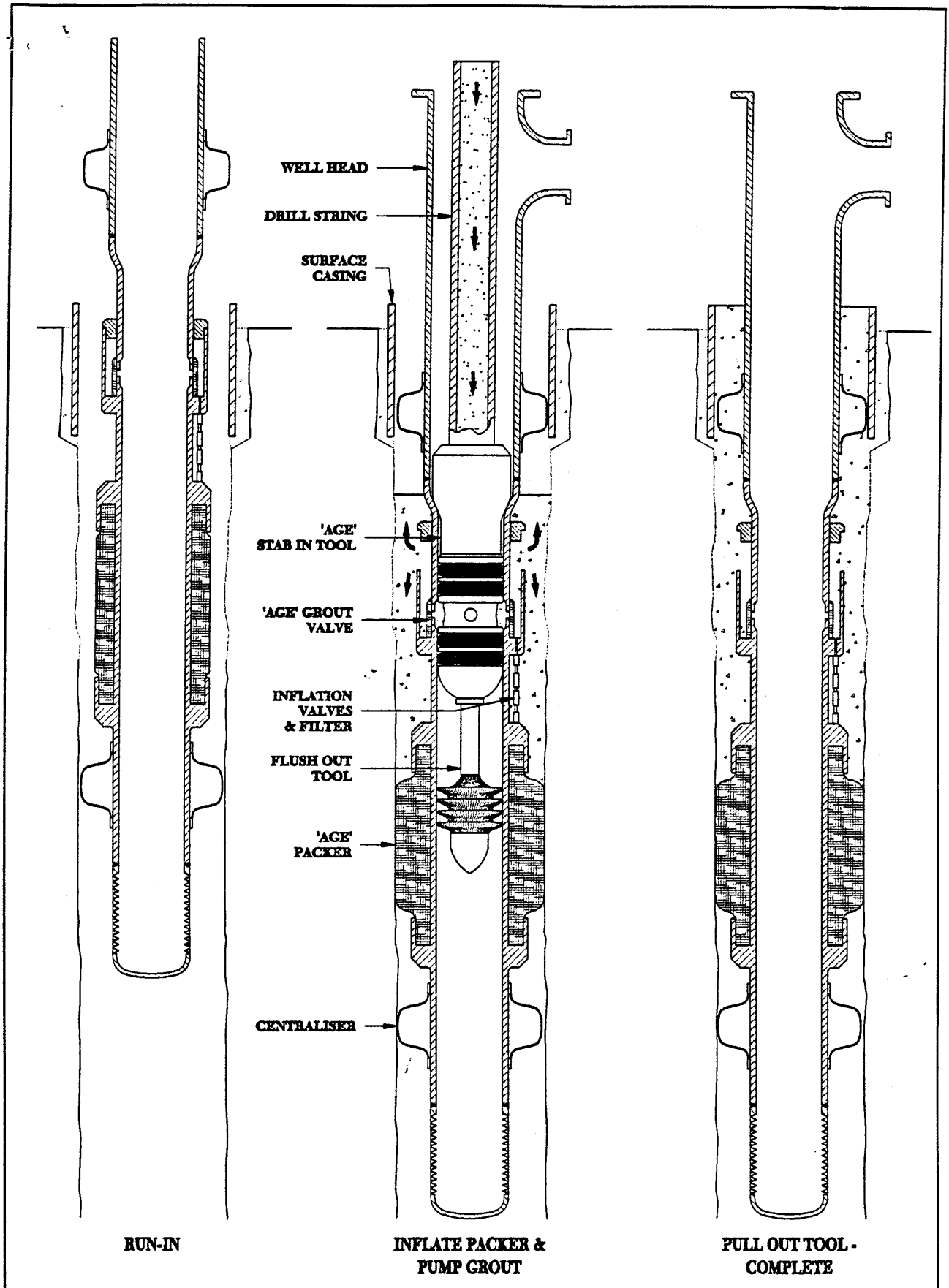


FIGURE 3 - DEEP BORES