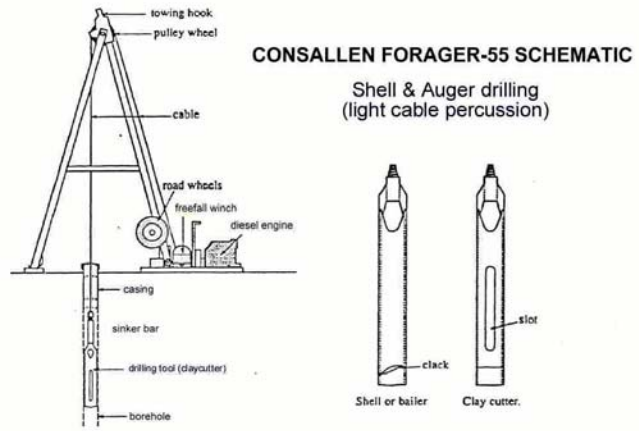
WHY CABLE PERCUSSION WELL DRILLING?

Because this technology for water well drilling is reliable in almost any material and very economical. The format allows drilling with minimal cost and modest capital, when compared with other systems that perform the same tasks at the same diameter. An equivalent rotary drill with the ancillary equipment is from 3 to 4 times the capital outlay.



Only one engine is employed, and no water or mud is needed, yet it will perform all the tasks required to drill, place casing, develop the well. No hydraulics, additional pumps or compressors are required to drill at 6½ or 8-5/8 inches diameter for the placement of 4", 5" or 6-inch permanent casing.

The system will handle, place, drive and recover temporary steel casing of several different sizes, in the same hole where required. In this respect it has the same attributes as much bigger rigs, but which are absent from all but the high end rotary machines. Mud does not support every type of material, but only the bigger expensive rotary machines will place and recover steel temporary casing.

The skills involved in using the system are easily learnt and taught. Drilling is intuitive and the results are obvious and can be seen at ground level. In a hole made by cable percussion, it is known if the water was drinkable, and of sufficient quantity before any permanent materials are installed. If it is found to be insufficient at that depth, the option of drilling deeper is available. A similar hole drilled by rotary mud flush cannot be assessed in the same way until it has been completed and pumped out.

The power employed by cable percussion drilling is small. The low capital cost allows new contractors or NGOs to enter the drilling business at modest investment. If they are successful, and can obtain more work of a similar kind, additional rigs will multiply their capacity incrementally.

Any water well has the same value in the market place, irrespective of the method of drilling. A lower cost method using less mechanical plant, but which may take longer has the same value as one made at the same place with big equipment but quicker. When the drill has been removed, the well performs the same function and the method of construction is not in evidence. If this method of drilling is price competitive in the same market, because the cost of equipment and consumables is low, speed does not matter.

Rotary drilling requires at least two engines to be running – perhaps more – at the same time, for the essential functions to operate:

1. Rotation is required – needing one engine to provide the necessary hydraulic power.
2. Flush is supplied by an engine driven pump, perhaps on a separate trailer, or a compressor – perhaps 2 mud pumps may be needed to supply suitable volume at adequate pressure. Centrifugal pumps have a falling head characteristic. As the pressure increases, the amount of fluid delivered decreases. Only expensive positive displacement pumps provide constant flow at a high pressure.
3. A foam injector may also be needed – another engine
4. In hard material a compressor, or compressors – and all the special tools – will be needed; with very thirsty engines. Compressed air is convenient, but is a particularly inefficient method of delivering power from engine to work place.

Some of these engines will be diesel and others petrol (gas). They all need both fuel and oil of a suitable type. These have to be obtained, stored and used safely. In Africa, petrol (gas) can often be difficult to obtain – diesel less so. All these engines and driven machines require maintenance, adjustment or up-keep Hydraulic rotary machines require replacement oil, filters and sophisticated 'understanding'. They also consume fuel.

The Forager-55/1250 rig shown here drilling in UK was powered by a 10hp diesel engine and operated by two men.

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With a cable tool rig, there is only one diesel engine and that is all. There are no centrifugal clutches, hydraulics, special oils or filters. The winch and engine are entirely mechanical and can be easily understood by most car mechanics. The F-55 winch has no clutch. The clutch function is provided by a simple band brake, which arrests the rotation of an epicyclic (planetary) gearbox – much more robust than any type of clutch.

When cable percussion drilling, it is obvious immediately both when water has been found, but also how much. The yield can be measured by bailing, samples taken, tested and even tasted. This is not possible with mud flush drilling because the mud masks everything. With a hole full of mud, there is no way to test either that you have found water, how much, or the quality. In order to do these things the hole must be cased and the mud pumped out. With cable tool these things are immediate because there is no mud, mud-pits, chemicals or disposal problem. Mud flush drilling requires a minimum volume of water equal to 3 times the eventual hole volume. Mud chemicals have to be purchased, delivered and stored in the dry until needed. If water is required for cable tool drilling it never exceeds the hole volume at the time, and no mud chemicals are required. The water required is small enough to be delivered by head pan, or bucket, and used a cup-full at a time.

In geology that has thin, weak yielding horizons, where the water is under very little pressure, it possible that mud used as the flushing medium may also destroy the aquifer being drilled. Mud, under pressure of a full borehole, is forced into the yielding layer to such an extent that it is mudded off – completely sealed. When the mud is removed, no water can flow into the well. The sealing effect of the mud used to make the hole has blocked off the water flow. This problem is helped if degradable mud is used, but this does not prevent the mud carrying natural clays and silts into the aquifer. There is almost no pressure in a weak thin aquifer to push the mud or natural clays out and to clear the way for water to flow into the well. Certainly there will be nothing like the pressure that was available to force the mud into the aquifer – that was the full height of the hole. The opposing pressure head will have been a few inches only.

Mud flush drilling may be difficult or even impossible where there is a risk of loss of circulation. Voids, or dry coarse gravel may absorb drilling fluids, which in extreme cases can result in hole collapse, and loss of tools.

SUMMARY

Cable tool drilling is often said to be slower – but is not that slow overall, and in many cases it is a quicker way of making shallow wells; a hole has the same value, whatever the drilling method or speed.

Cable tool uses less equipment at about 1/4 to 1/3rd the capital cost of a rotary drilling set-up of similar capability.

Cable tool drilling has very low inputs. Some fuel, some labour, some water – that is all.

Holes have the same value, whatever the method of drilling, so a low capital method has considerable merit.

Tools are cheap for cable tool drilling. There is the cable and tools to hang on the end of it; and everything, except the wire, can be made by a reasonable welder using scrap steel.

There is less chance of getting the tools stuck because they spend so much time out of the hole, and can be pulled up in a moment – unlike rotary drill tubes.

Cable tool drilling can deal with boulders and large stones that will defeat a normal rotary rig; it can even drill solid rock – all without additional equipment.

Cable tool drilling allows the hole to be cased at the same time as it is advanced, and the water can be tested for quantity and quality without loss of materials.

FURTHER NOTES ABOUT THE PICTURED RIG:

The small diesel engine on this rig uses about 5 litres of diesel fuel per day – just over 1.3 US gallons. The mixed conditions found at this site are typical of UK drilling, which is why the 'shell & auger' method of cable percussion drilling method is so popular - it will drill anything.

A variety of drilling tools was used to tackle the varied strata, including temporary casing. A bailer with a leather clack was used, a clay cutter, a stubber, sliding hammer and a cross bit to break flints and boulders. The maximum weight of tools & sinker was about 160 Kg even when driving casing. A high window clay cutter was also used with a retaining device to hold the more difficult material.

Hauling out the 800 kg of temporary steel casing required the use of a 3-part tackle (3 falls of wire and two snatch blocks) and the leg braces were all in place during the process. A three-part tackle on this particular machine generates about 3750 Kg of hoisting power (say, 8250 lbs.). A 5-part tackle has been used with the same machine, and 7 falls of wire are possible, multiplying the winch hoisting capacity by 7.

NOTE ABOUT MUD, PITS & PUMPS

In order to drill using rotary mud flush, it is generally recognised that the volume of mud pits should be about equal to 3 times the eventual borehole volume. So for a hole intended to be 6 inches diameter, and 100 feet deep, mud pit volume should be about 59 cubic feet. Since this is greater than the volume of the first metre of a hand dug well 4½ feet diameter, it would be expected that mud pit excavation might take a whole day's work in typical African conditions. Then sufficient water would need to be brought to fill this volume – about 3100 lbs., 1400 litres, or 1.4 tons of water. Also, it should be remembered that mud pits do not happen by themselves, they need supervising, and to be in the right place. Along with the water, the mud powder must be delivered in good condition and ready to make lump-free mud.

With the addition of mud cleaning equipment - another piece of powered plant – the volume of mud required may be reduced. When using positive displacement mud pumps a mud cleaning system is essential.