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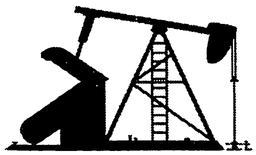


Oil Wells and Equipment

Intro: The Placerita Canyon Nature Center has a number of items of old oil field equipment displayed at the Heritage trail. The Heritage Trail guide provides an accurate description of the equipment, but content of this paper may be of benefit to anyone desiring a little more information. Also included is a brief review of Placerita oil history and basic information on the subject of petroleum and how it is procured.

Local Oil History

The discovery and production of petroleum is of significance in the history of the Santa Clarita Valley, including Placerita Canyon. Some of the countries earliest drilled wells and a refinery were established locally. Oil production in Southern California started in the Newhall area around 1850, when natural oil seeps were crudely distilled and used as "burning oil" at the San Fernando Mission. In 1874 a refinery was built in Newhall near Sanford Lyon's stagecoach station. Oil in greater quantity was found two years later when Pico Number 4 at Mentryville (Pico Canyon) began producing. It was the first commercially successful drilled oil strike in California, and the Pico Canyon oil field proved to be the richest in the state's history to that time. Mentryville was a thriving oil town from 1876 to 1900. Also in 1876 the Pioneer Oil Refinery, the only significant refinery in California at the time, was moved to Pine Street and expanded to accommodate the increased oil production.

Oil continues to be pumped in Placerita Canyon west of Highway 14 and also near Castaic but it is refined elsewhere.

Placerita Canyon Oil In 1898 Frank Walker's grandfather leased some Placerita Canyon land to an oil company. Two years later their drill rig hit pure "white oil", an unusual geologic occurrence, a form of petroleum found only in a few areas of the country

Years later, the ingenious Canyon resident Frank Walker built an oil-gas-water separator to extract "white oil" from four wells on his Placerita Canyon property (now part of Placerita Canyon park). He used the naturally refined petroleum to run his Model T Ford and piped natural gas from the wells for light and cooking in their home. George Starbuck, who grew up in the vicinity of Placerita Canyon said that as a teen-ager (late 1930's to early '40s) he would take a 5-gallon can to his great uncle Tom Walker's white oil well, fill it up and use it to fuel his Model A Ford.

"White oil" can still be found seeping from the ground at the Canyon Trail in the park. Experts who examined the oil in a 1974 study for the county of Los Angeles called it "a unique geologic oddity" as it seems to be refined by nature. The oil consists of 83% low-grade gasoline and is almost clear. According to the study, the movement of the oil from the original source through the fine sands and clay of the San Gabriel Fault Zone created a natural filtration system for the clear, kerosene-like oil. Others say it is the filtration through the cracks and crevasses within the "Placerita schist" (crystalline rocks) along the Placerita Fault, that accounts for its properties.

How oil (petroleum) was formed - Petroleum is believed to have formed in ancient sedimentary beds of vegetable and animal debris. With little or no oxygen present, microorganisms broke down the concentrated organic materials. Heat and pressure caused the materials to distill into crude oil and natural gas in a source rock, commonly shale. Some of the oil migrated into porous sandstone or limestone rock. In order for liquid oil to be obtained economically, it must be present in a porous rock material yet be contained by an impermeable cap rock to prevent it from escaping.

The petroleum usually accumulates into layers with natural gas at the top, liquid oil next, and water below. The liquid oil and gas can migrate due to the effects of water flowing slowly within the rock strata and cause the oil to be trapped in "reservoirs" within the porous rock. When oil is concentrated in a trap or reservoir, an oil field forms from which liquid oil can be extracted by drilling and pumping. In many areas the oil is contained in shale or sand and is difficult to extract. Wells produce best when first drilled. Occasionally there is sufficient underground pressure to force oil to the surface but all wells have a decreasing production as oil is depleted. Commonly, additional wells are drilled in oil fields so water, steam, carbon dioxide or chemicals can be injected to force increased production in nearby wells. These are called "secondary" production methods and account for a large percentage of oil produced. Locating underground oil is often accomplished by setting off surface or underwater explosions and tracking the speed of the sonic wave that reflect off of materials below the earths surface.

Drilling for oil – (Refer to **Illustration A** and **Glossary** to clarify bold/underlined items)

Every drilling operation is unique due to the myriad or factors affecting the process. Certainly the materials and strata to be drilled are of primary consideration. Additional factors such as surface conditions, final depth of the hole, water table, natural gas bearing formations, and many others often unknown at the onset of drilling must be dealt with as they arise. Strict environmental regulations govern most activities.

The material being drilled generally dictates the drilling bit type, either the **drag bit** or **rotary bit**. **Drag bit**s use a scraping motion to remove softer materials and **rotary bit**s are best suited for rock and other hard surfaces. Drag bits are becoming more popular and versatile as design improves and wear resistant materials are incorporated on the cutting surfaces.

A drilling rig performs the drilling operation. A **rotary table** turns the drill by turning the shaft or pipe to which the bit is connected. As the **down hole** is drilled, metal **casing** sections are installed and cemented in place to prevent caving of the well walls. As the drilling operation progresses, water and mud are pumped into the bottom of the hole to force the rock and debris up to the surface for disposal. Compressed air is often injected at the cutting bit to facilitate drilling. When the hole is drilled to the desired depth and has entered an **oil-bearing zone**, the final **casing** section is inserted and **perforations** or holes are made in the casing walls either mechanically or by explosive charges. The perforating procedure is necessary to allow oil from the oil-bearing strata into the well. A **down-hole pump** and **tubing** is installed into the well. A string of **sucker rod**s is connected to the movable part of the pump. When a well is completed, the above ground pumping apparatus or **pumpjack** is installed. These are the familiar **Horse Heads** or Nodding Donkeys seen prominently at oil field sites.

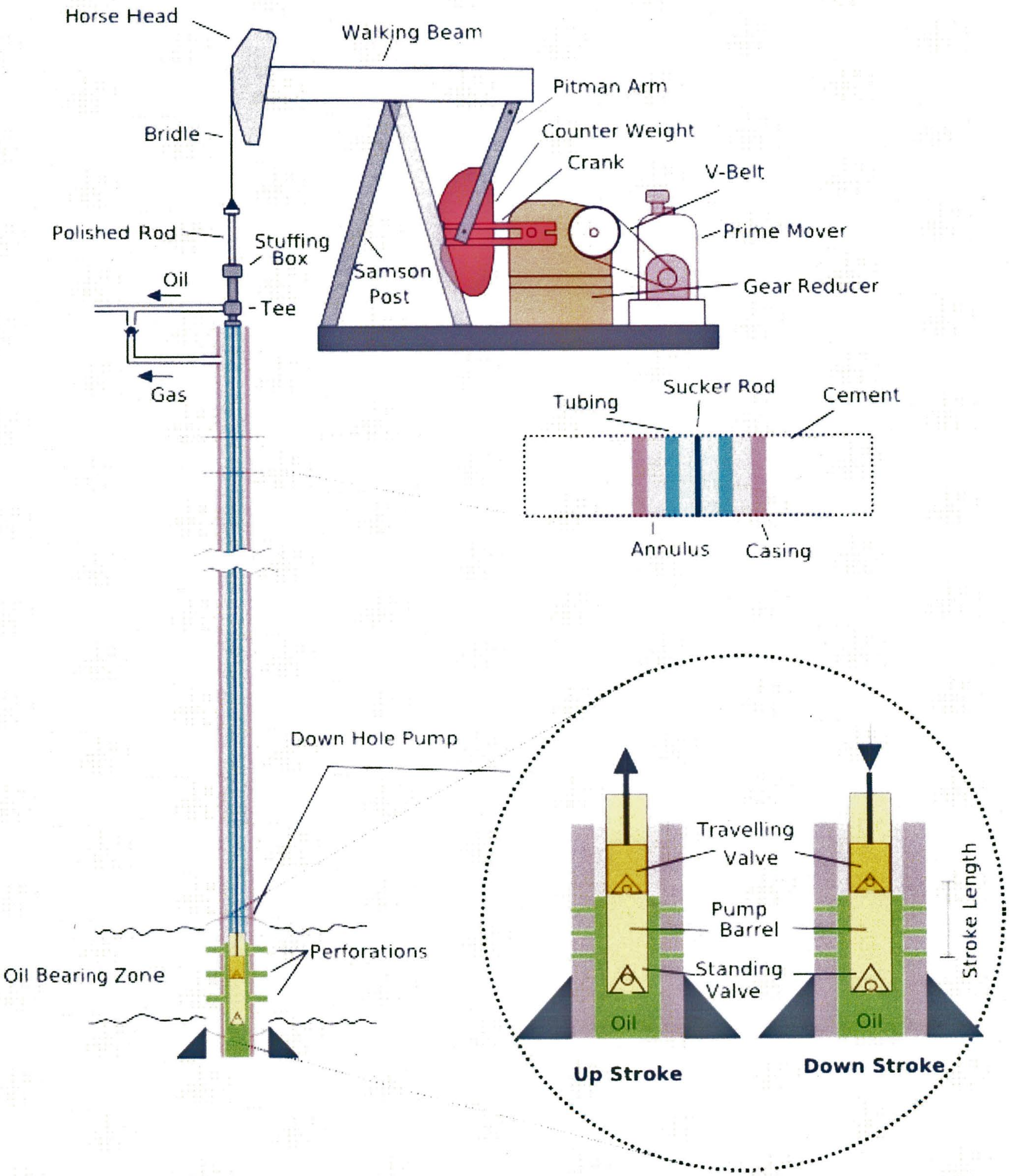
Pumping Oil -

Pumping is achieved as the **walking beam** is driven up and down by an electric motor (**prime mover**) through a **gear reducer** and **pitman arm**. **Counter weights** help lift the sucker rod string. A **bridal** connects the **horse head** to the **polished rod** through a **stuffing box** or seal above the **tee**. As the **polished rod** reciprocates, the attached assembly of connected **sucker rods** transmits the movement to the **traveling valve** at the **down-hole pump**. The pump also contains a **standing valve** as part of the pumping unit in the pump barrel. The above ground drive system forces the pump up and down, creating suction that lifts oil up through the **tubing**, sometimes 10,000 feet or more. Wells may pump 1 -10 gallons per stroke.

TERMS GLOSSARY

Annulus – space between the tubing and the casing in a well. This is the area that a packer seals
Blowout preventer – a device at the top of a well during the drilling operation that helps prevent damage or fire in case of sudden pressure within the well
Casings – a steel liner cemented into a well. Provides various functions
Check Valve – or ball check valve a type of valve that allows liquids or gas to move in only one direction.
Christmas Tree – Assemblage of valves, fittings and a stuffing box at the top of the well (wellhead) to control oil/gas out of the top of the well
Counter weight – weights on the pumpjack crank that counterbalance the weight of the string of sucker rods thereby reducing the power required to operate the pump
Down-hole Pump – piston pump unit at the bottom of the well. Operated by reciprocating movement of the sucker rod string
Drag bit – A rotating drill with natural and man-made diamond wear surfaces, usually with compressed air blown into the area being cut. Suitable for soft to medium materials
Gear Reducer – assembly of gears that reduces speed and increases torque to drive a pump
Horse head – AKA nodding donkey, nodding grasshopper, thirsty bird. The part of the pumpjack to which the pumping assembly is connected by the bridal
Oil Bearing Zone – A porous geologic strata containing petroleum
Perforations – Holes punctured into the casing at the same level as the oil-bearing zone to allow oil to flow into the down-hole pump area
Packer - an expandable plug used to seal or isolate sections in a well
Pitman Arm – rod or arm that connects between the counter weight and walking beam
Polished Rod – a special sucker rod machined and polished to function as a sliding seal at the stuffing box
Pump barrel - part of the down-hole pump
Pumpjack – the above ground drive for a sucker rod pump installed in an oil well
Prime Mover – power source for a pumping or drilling unit. Usually an electric motor or internal combustion engine
Rotary or roller cone bit – drill type, consisting of teeth on wheels which turn as the bit is rotated. The teeth apply a crushing pressure to the rock, breaking it into small pieces. This bit is especially suited for hard formations
Rotary Table – device used to turn the drill pipe and bit when a well is under construction
Standing Valve - at the down-hole pump, a check valve assembly, often just a cage and ball that allows oil into the pump barrel from the well
Stuffing Box – packing box that seals oil and gas from leaking by the movable polished rod
Sucker Rod - A steel rod that is used to make up the mechanical assembly between the surface and downhole components. The rods are 25 to 30 feet in length and threaded on each end
Tee - commonly referred to as the Christmas tree due to the numerous valves and pipes attached
Tubing - Production tubing – the tube or pipe that brings oil from the down-hole pump to the wellhead
Traveling Valve – at the down-hole pump, a check valve assembly, often just a cage and ball that allows oil to pump up the tubing but not back down
Walking Beam – moving beam on the pumpjack that pivots resulting in the reciprocating pump motion
Well head – control equipment fitted to the top of the well, consisting of outlets, valves, blowout preventer equipment, etc

Pumpjack, Well, & Downhole Pump



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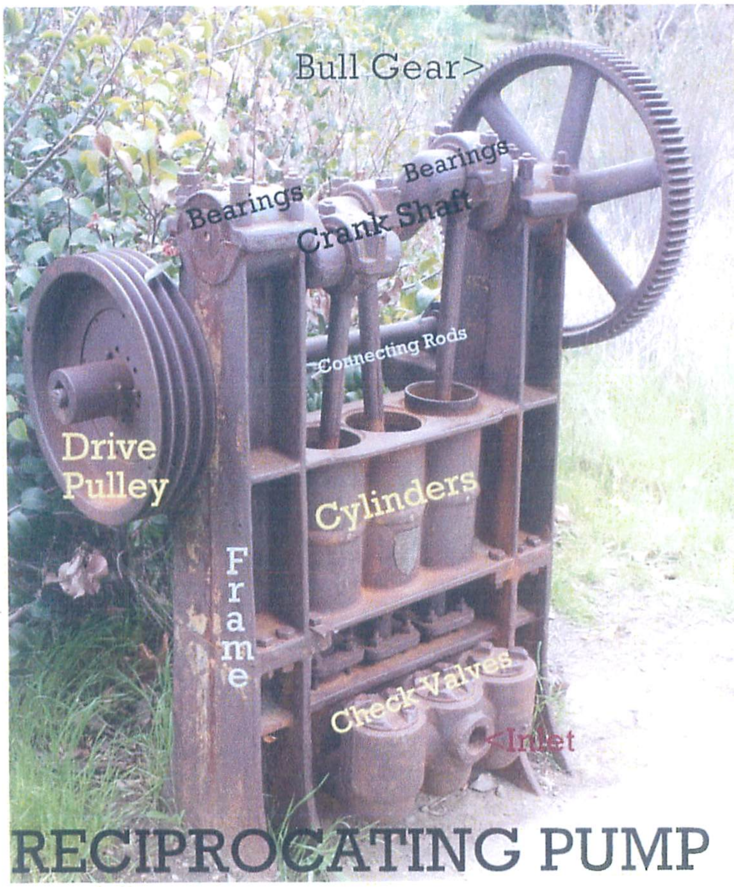
The Oil equipment on the Heritage Trail



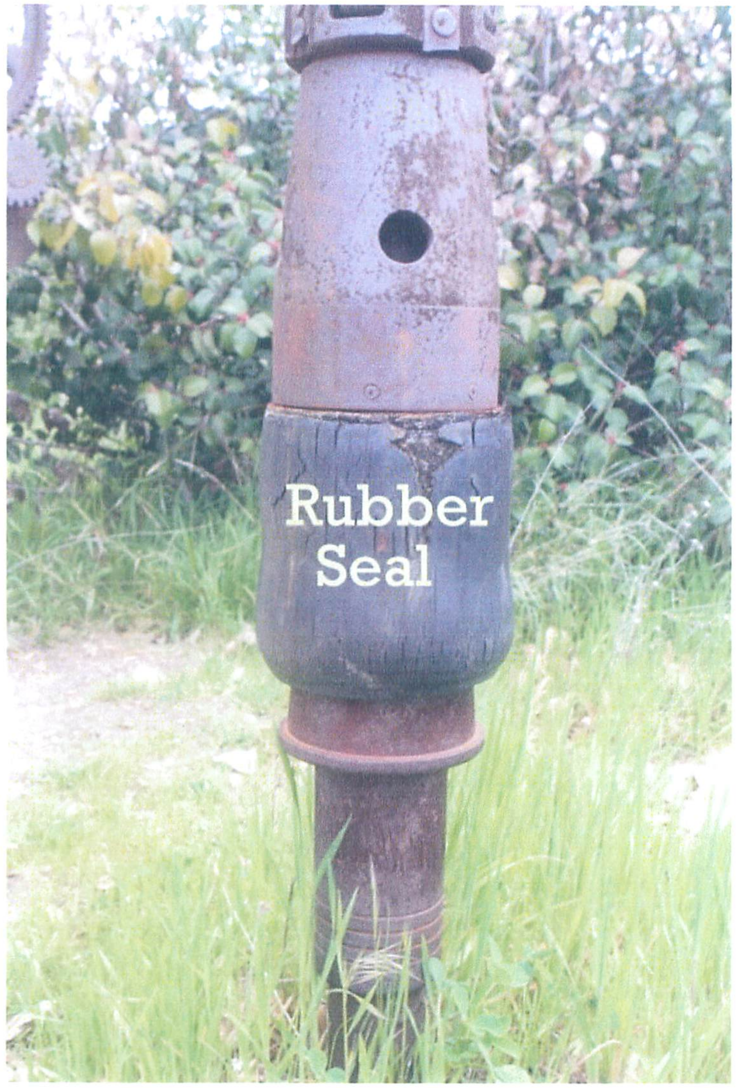
The pump on display was probably used to pump oil to the refinery or to storage tanks in the Placerita oil fields. It may have been used to pump water as necessary. It is a positive displacement three cylinder or triplex pump with a 3-inch bore and 6 inch stroke. The pump was driven by an electric motor or gas powered internal engine through drive belts to the pulley on the left side of the pump. The drive pulley rotates a shaft (visible behind the connecting rods) and a small (Pinion) gear that meshes with the Bull Gear. The Bull Gear drives the Crank Shaft that alternately raises and lowers the 3 pistons via the Connecting Rods. As the pump is turned, the crankshaft raises the pistons and draws oil up through the check valves on the front side of the pump and into the cylinders. As the crankshaft continues to turn it drives the piston down forcing the oil at high pressure out through another set of check valves to the outlet at the back of the pump. The Goulds Manufacturing Company of Seneca New York manufactured this pump in the early 1900's. Goulds began by manufacturing wooden pumps in 1839. The company has been a leader in pump technology and continues as a major manufacturer today.

Tricone Rolling Surface Rock Bit

Typical tricone bit (unused)

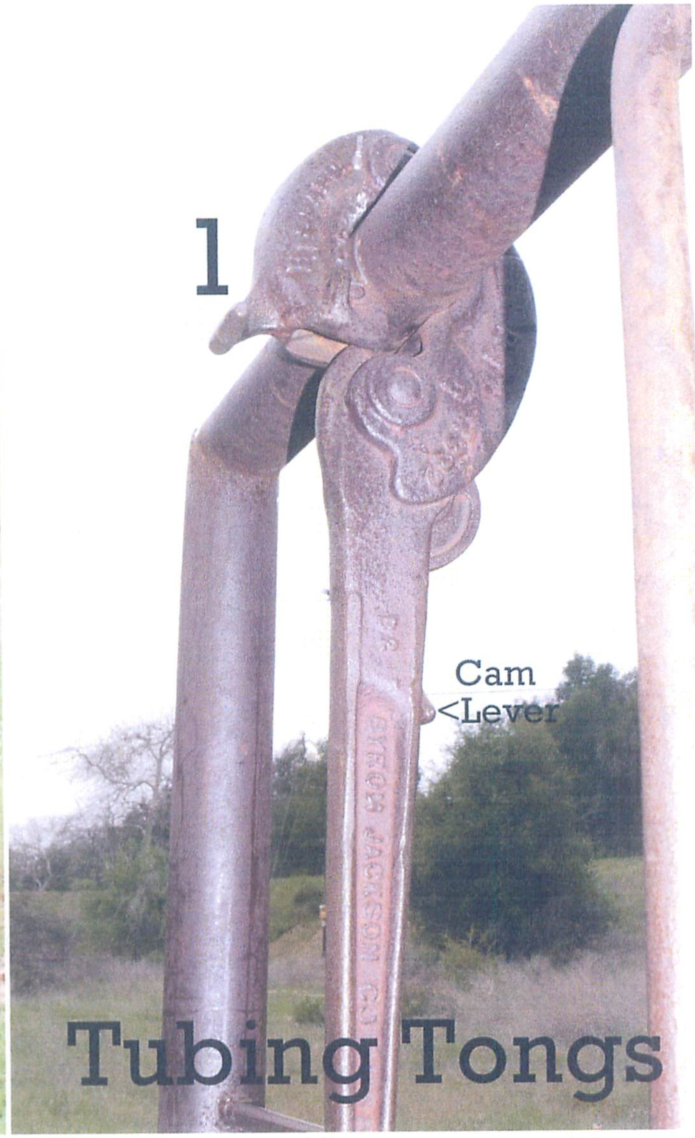
Also known as, **Rotary Bit, Roller Bit**, **Roller Cone Bit, Rotary Rock Bit**,. A type of drill head (bit) used for drilling in rock and hardpan materials. The bit consists of teeth on wheels which turn as the drill string is rotated. These teeth apply a crushing pressure to the rock, breaking it up into small pieces.

The original patent was issued to Howard Hughes Senior in 1909 for his dual cone roller bit, an innovative new drill bit that allowed drilling in previously undrillable rock structures. It consisted of two interlocking wheels. Walter Benona Sharp worked very closely with Hughes in developing the rock bit. The success of this bit led to the founding of the Sharp-Hughes Tool Company. In 1933 two Hughes engineers invented the tricone bit, with three wheels instead of the original two. The Hughes patent for the tricone bit lasted until 1951, at which time other companies started making similar bits. Hughes still had 40% of the world's drill bit market in 2000.

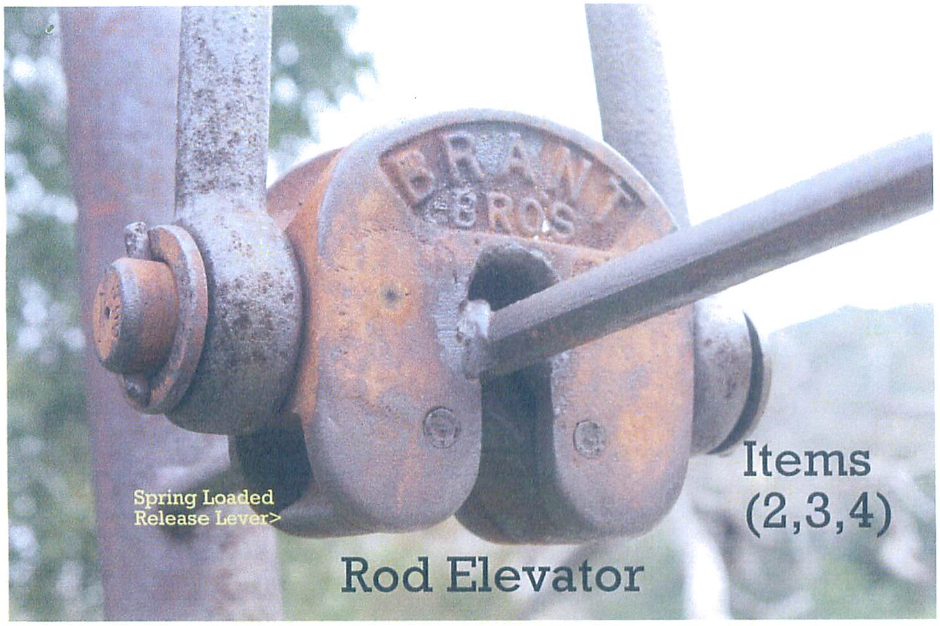


Hook Wall Pumping Packer (a type of production packer)

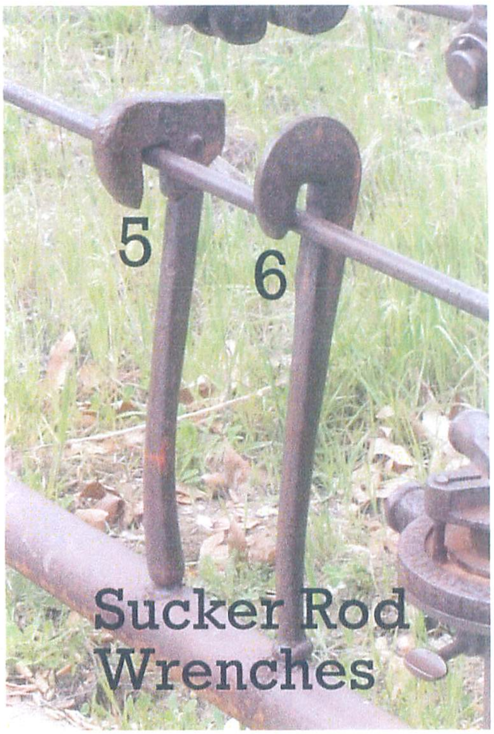
A packer is an expandable plug used to isolate sections in a well or borehole. This type of packer is used where natural gas and oil is being produced in the well. The packer is attached to the oil tubing and lowered into a casing or hole (depending upon the type of rock) at a specific depth but above the Down-hole Pump. At that point the rubber seal is allowed to expand, permanently locking and sealing the packer to the casing or well wall. As natural gas comes into the well it cannot enter the area between the casing and the pump tubing (annulus) so it causes pressure in the tubing. This pressure helps pump function by forcing oil through the tubing to the surface. The gas also mixes into the oil, reducing its specific gravity making it easier to pump to the surface.



1 Tubing tongs are a type of pipe wrench that securely locks onto the pipe until released. The tongs have a cam lever which is used to open the jaw and to lock them onto the pipe, assuring a positive grip. Tubing runs the entire depth of the well, as it is the "pipe" or conduit for all of the oil pumped out of a well. Commonly there are hundreds, if not thousands of feet of tubing in a well.



2 – 4 A Rod Elevator clamps to a sucker rod to allow a crane to lift or elevate the sucker rod string. Two spring loaded release levers on the rod elevator must be pressed to release it from the sucker rod. The rod elevators must be used whenever sucker rods are installed or dis-assembled in a well. The tool is required to be able to support the sucker rod string which may weigh thousands of pounds



5 Snap-action Rod Buster. Used for manual assembly and disassembly (makeup and break out) of Sucker Rod joints. Note the fulcrum at the base of the handle. The handle is swung quickly and as it comes to the end of its 90 degree travel, the sudden stop adds extra force when tightening or separating the rods.

6 Conventional Sucker Rod wrench. This wrench is used to hold the rod while the snap-action wrench is used. The combination of these tools speed up the tedious job of assembling/disassembling possibly hundreds of rods in a single well.

7 Pipe Threader or Tubing Threader. This manual threader appears to be sized specifically for cutting threads on well tubing. The same size pipe was probably used for a number of applications at the well site. Oil handling required pipe for use in drilling, pumping, and moving oil to tanks or trucks. Pipe was also threaded for water and gas in oil field construction and operation.