

Tikrit University
The College of Petroleum Processes
Engineering
Petroleum and Gas Refining Engineering
Department

An Introduction to Petroleum Technology

First Class

Lecture (11)

By

Assistant lecturer

Luay Ahmed Khamees

11-1 Classification of drilling operations:

- 1- Exploration drilling: drilling operations for the purpose of obtaining integrated information about the nature and contents of the formations and rocks penetrated, and this is done by extracting the core and well logging equipment.

- 2- Exploitation drilling: It takes place in regions where all stages of exploratory drilling have ended, and aims to economically invest the discovered fields.

- 3- Injection Drilling: These wells are drilled for the purpose of secondary or tertiary recovery. Through these wells: water, gas, steam, air, or some chemicals are injected into the reservoir.

11-2 Types of drilling

11-2-1 Cable – Tool Drilling:

The first oil well in the United States of America was drilled by cable tool in 1859 with a depth of 65 feet, the famous historic Drake well. This drilling method is also called the Churn or Percussion method. In this method, drilling is done by the action of hammering the steel bit, which is alternately raised by a steel rope that allows it to fall,

resulting in successive sharp blows to the bottom of the well.

There are two types of Cable Tool Drilling:

- a- Dry Cable Tool Drilling: Small amounts of water are used in it for the purpose of cohesing cutting of rock and to facilitate their removal by “bailer”. Dry drilling is done either by using a rope or a shaft.
- b- Hydraulic Cable Tool Drilling : Drill pipes are used through which drilling fluid is pumped for the purpose of cleaning the well and transferring the drilled rock crumbs to the surface.

This leads to an increase in drilling speed and well hole stability.

In both types of Tool Drilling drilling, the speed of drilling depends on: the number of strokes per unit time, the force with which the bit hits the bottom of the well, and this force depends on the weight of the bit, on the drill stem, and on the height from which the bit falls, which is called a “walking beam stroke”.

في كلا النوعين من أدوات الحفر ، تعتمد سرعة الحفر على:

عدد الضربات في وحدة الزمن ، والقوة التي تضرب بها الحافرة قعر البئر ، وتعتمد هذه القوة على وزن الحافرة وساق الحفر والارتفاع الذي تسقط منه الحافرة وهو ما يسمى " شوط الذراع المتأرجح "

11-2-1-2 Advantages of Cable tool drilling :

The main factor that controls the choice of drilling method is the economic factor (cost). In many shallow areas, the cost of hammer-drilled wells is likely to be lower than that of Rotary-drilling.

11-2-1-3 Disadvantage of Cable tool drilling:

- a- The greater the depth, the slower the drilling speed.
- b- The lack of automatic control over the high pressures that are present in the formations that are being drilled due to the lack of drilling fluid, and this leads to the risk of blow out .

11-2-1-4 Application of Cable Tool:

- Drilling operations in productive layers that are damaged by the use of drilling fluids.
- At the beginning of drilling at depths close to the surface .

11-2-2 Rotary Drilling:

In the rotary drilling method, the well is drilled by rotating the drill bit on which a weight is placed downwards so that it is in direct contact with the bottom of the well, and this drill is connected to the Drilling String by which the drill rotates.

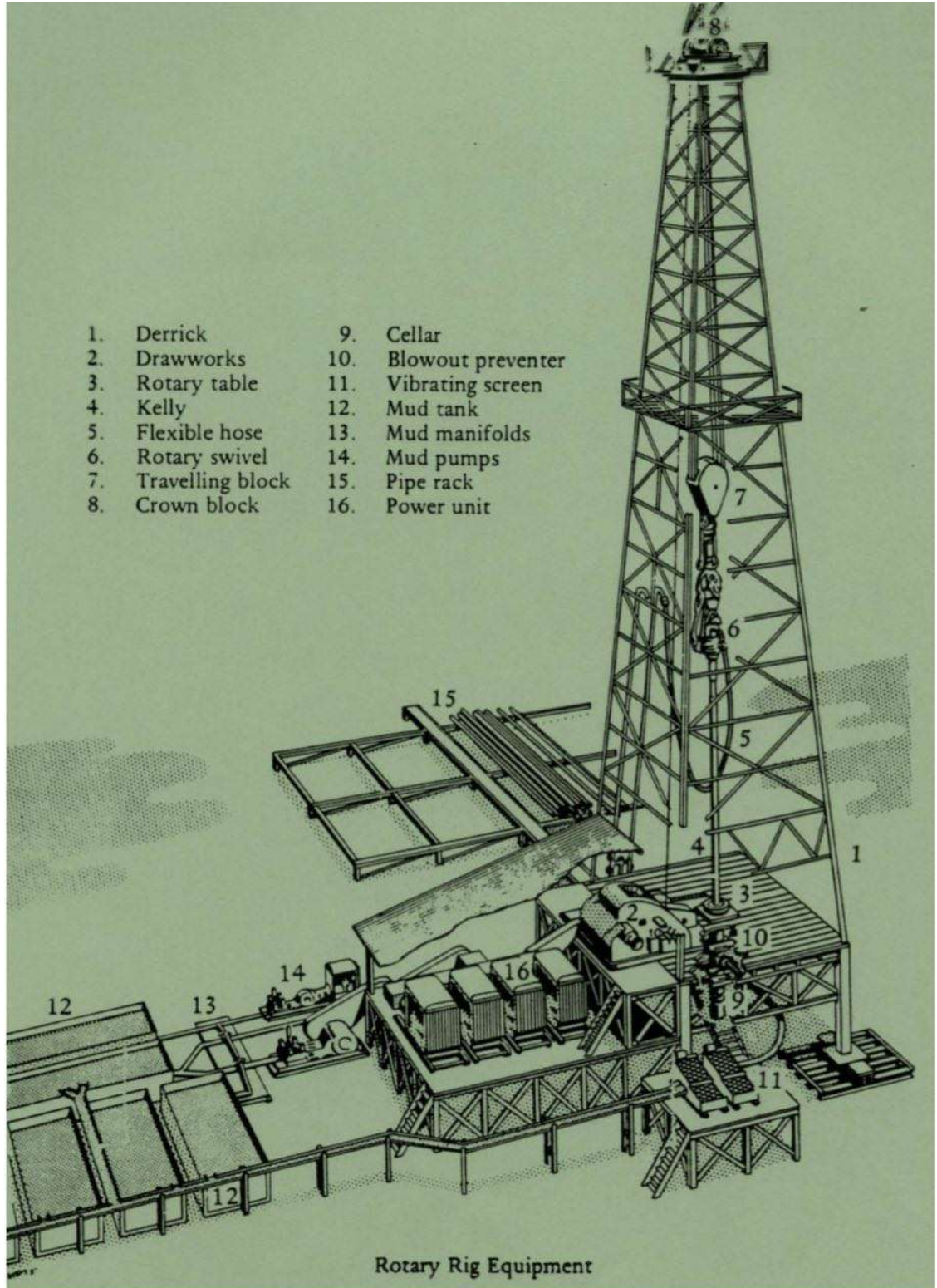
In this method, the cut pieces of the drilled rock are removed from the well by the drilling fluid that is continuously circulated from inside the drilling column downward through nozzles located in the bit, and then this fluid ascends in the annular space between the drilling column and the well wall back to the surface. On the surface, the returning drilling fluid is transferred to a series of basins or pits, where it remains in a calm state for a sufficient period of time to allow the deposition of the excavated pieces of rock. In the last basin of these basins, the drilling fluid is withdrawn by a suction pump, and this cycle is repeated continuously.

11-3 Types of rigs:

- 1- Land rigs
- 2- Offshore rigs.

11-3-1 The main components of drilling rig:

- | | |
|-----------------------------|--------------------------|
| 1- power system | منظومة القدرة |
| 2- Hoisting system | منظومة الرفع |
| 3- fluid circulating system | منظومة تدوير سائل الحفر |
| 4- well rotary system | منظومة التدوير |
| 5- well control system | منظومة السيطرة على البئر |
| 6- well monitoring system | منظومة مراقبة البئر |



1-Rig power system:

Modern rigs are powered by internal combustion engines and generally subdivided into:

- a- Diesel –electrical type
- b- The direct drive type.

2-Hoisting system:

The system provide a means of lowering or raising the drillstring, casing string and other subsurface equipments into or out of the hole.

The principal Components of this system are:

- a- Derrick and substructure البرج والهيكـل القاعدي
- b- Blocks (crown block, travelling block) البكرات
- c- Draw work. مجموعة الرفع
- d- the drilling line خيط الحفر

3- Circulation system:

The major function of the fluid circulation is to remove the rock cuttings from the hole.

Principle components of circulation system are :

- a- mud pumps
- b- mud pits
- c- mud mixing equipment
- d- Contaminate removal equipment which include (shale shaker, hydro cyclones centrifuges and degasser)

4- Rotary system:

- a- swivel
- b- kelly
- c- rotary drive
- d- rotary table
- e- drill pipe
- f- drill collars.

Swivel: is which allowing the passage of drill fluid coming from mud hose in to drilling string. It prevents the rotation of the drilling line and connects below it kelly

Kelly: is a ribbed tube to fit with the rotary table so as to transfer rotation motion of all parts of drilling string.

Drill pipe: serves as medium for transmission of rotary motion to the bit and as passage for mud.

Drill collars: is a steel pipes with a thick wall with large outside diameter to provide compressive load on the bit and allow the drill pipes to be in a state of tension.

Rotary table: its task

a. Transfer rotational motion to **drilling string**. نقل الحركة الدائرية الى خيط الحفر.

b. Suspend the weight of drilling pipe during the process of connect pipes. تعليق خيط الحفر اثناء تعليق الانابيب

Drilling string components:

- a – Kelly.
- b- Tool joint.
- c- Drill pipe.
- d- Drill collars.
- e- Bit.

Bit: there are three types of bit: 1. Drag type 2. Roller bit
3. Diamond.

5- Well control system: it prevents the uncontrolled flow of formation fluids from the well bore.

Kick : the flow of formation fluids into the well in the presence of drilling fluid (occurred when formation fluid pressure greater than hydrostatic pressure of mud drilling) .

Well control system functions are :

- 1- Detecting the kick (by pit : volume indicator or flow indicator)
- 2- Closing the well at the surface.
- 3- Circulating the well under pressure to remove the formation fluids.
- 4- Diverting flow away from rig personal.

Well control system consist of:

- a- Blow out prevent (BOP) : a high pressure valves which seal off the top of the well.

Blow out preventers (BOP): the main task of blow out preventers is to ensure a means to close the annular between drill pipe and casing.

There are two types of BOP which are:

- Ram (Blind and shear) preventer.
- Annular preventer.
 - b- Chock manifold : a high pressure circulating system used for circulating kick.

6. Well Monitoring system:

A system of devices records or display measure the following parameters:

- a- Depth.
- b- Penetration rate.
- c- Hook load.
- d- Rotary speed.
- e- Rotary torque.
- f- Pump rate.
- g- Pump pressure.
- h- Mud density.
- i- Mud salinity.
- j- Gas content.

