ORISSA SCHOOL OF MINING ENGINEERING
KEONJHAR

DEPARTMENT OF DRILLING ENGINEERING

LABORATORY MANUAL

DRILLING MACHINERY-I LABORATORY

Semester: III

Branch: DRILLING ENGINEERING

Course: DRILLING MACHINERY-I LABORATORY

Subject Code: Pr.1

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LECTURER, DRILLING ENGG

VISION OF THE DEPARTMENT:

To produce quality drilling engineers, those can be valuable resources for the nation as well as for the world on problem solving and technological development.

MISSION OF THE DEPARTMENT:

1. To develop state of art facilities for classroom and laboratory related to Drilling engineering which fortify students with strong fundamental concepts, analytical capability, and problem solving skills.
2. To collaborate with different national and international organisations in same dimension which promote learning beyond curriculum and skill of new technology.
3. To develop human potential to meet industrial and societal requirement.

PROGRAMME OUTCOMES (PO)

PO1.Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

PO2.Problem analysis: Identify and analyse well-defined engineering problems using codified standard methods.

PO3.Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

PO4.Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

PO5.Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

PO6.Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

PO7.Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

PROGRAM SPECIFIC OBJECTIVE (PSO)

PSO1: Study about Basic mathematics, Science and Engineering fundamentals, Geology, Surveying Method, different Drilling methods according to application, Machineries associated with it and Terminology used in drilling.

PSO2: Select appropriate Surveying method to locate bore holes and drilling site preparation. Tools and drilling methods selection keeping in view of Geological condition of bore hole Drilling rate, Core recovery and purpose of drilling.

PSO3: Analyse the problems associated with preparing drilling site, locating bore holes, geological formation, core recovery, drilling tools, drilling procedure and well conditioning during drilling operation and find out the solution to it and design a bore hole.

PSO4: Able to manage drilling project, become an entrepreneur in drilling field and practice sustainable development.

PROGRAMME EDUCATIONAL OBJECTIVE:

PEO1: To gain fundamental and advance knowledge related to drilling engineering.
PEO2: To opt out for higher study for carrier development.
PEO3: To gain employment in Government, Public and Private sector organisations in India and abroad also.
PEO4: To solve industrial problems with/without engagement in industry.
PEO5: To become an entrepreneur and create employment opportunities for others.

Course	Statement
C206.1	**Show** how to operate and maintenance of different units of drill rig.
C206 .2	**Explain** mechanism of different units of drill rig and drill string.
C206 .3	**Analyze** vibration in drill rig
C206 .4	**Evaluate** causes of fish, core loss and vibration in drill rig
C206 .5	**Modify** drill rig components, drill string and drilling parameters for better drilling, core recovery and **Propose** fishing procedure.

3.1.2. CO-PO matrices of courses

Semester-3rd Semester Subject-Drilling Machinery-I Lab & Sub Code: Pr.1

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C206.1	3	3	3	3	1	3	3
C206.2	3	3	3	3	1	3	3
C206.3	3	3	3	3	1	3	3
C206.4	3	3	3	3	1	3	3
C206.5	3	3	3	3	1	3	3
C206 TOTAL	15	15	15	15	5	15	15
Correlation Level	**3**	**3**	**3**	**3**	**1**	**3**	**3**

Course Outcome	PSO1	PSO2	PSO3	PSO4

C206.1	3	3	3	3
C206.2	3	3	3	3
C206.3	3	3	3	3
C206.4	3	3	3	3
C206.5	3	3	3	3
C 206 TOTAL	15	15	15	15
Correlation Level	**3**	**3**	**3**	**3**

1: LOW 2: MEDIUM 3: HIGH

DRILLING MACHINERY - I LAB

Name of the Course: Diploma in Drilling Engineering			
Course Code	**: Pr.1**	**Semester**	**: 3rd**
Lab Periods	**: 6 Periods/week**	**Sessional**	**: 50**
Total Periods	**: 90**	**End Semester Examination**	**: 50**
Examination	**: 3 Hours**	**Maximum Marks**	**: 100**

RATIONALE

It is imperative that a drilling engineer should be thoroughly conversant with various types of drilling machine, accessories, instruments and fittings for supervising any drilling operation.

OBJECTIVE

On completion of the course, students will be able to:

1. Understand the mechanism of different units of drilling rig..
2. Know the effects of vibration.
3. Understand the mechanism of different core barrels.
4. Use and application diamond and T.C. bits according to the rock formations.
5. Find out the fish causes of obstruction of further progress of drilling.
6. Understand the operation of different engines, motors and pumps used in drilling operation

COURSE CONTENTS

1. Study of drilling accessories, instruments and fittings.

2. Study of different fishing tools.

3. Study of different drill machines, different units of rig by disassembling and assembling.

4. Practicing the starting of Diesel Engine, Petrol Engine and Running Electric Motors.

5. Study of different types of water pumps and different units of reciprocating pump, centrifugal pump, turbine pump, mono pumps, submersible pump etc by disassembling and assembling.

6. Practicing operational techniques and maintenance of rig, Simplex, Duplex and Triplex pump at site.

7. Practicing the operation of rig at the site.

N.B.: Students will submit their sessional records for evaluation on completion of course. Individual viva-voce test will be conducted by the internal/external examiner at the end of the semester.

Laboratory Safety Rules

1. Personal Protective Equipment (PPE):

- **Lab Coat:**

Always wear a lab coat to protect your clothing and skin from spills and splashes.

- **Eye Protection:**

Wear safety goggles or glasses to protect your eyes from splashes, fumes, and other hazards.

- **Gloves:**

Use appropriate gloves when handling chemicals, biological materials, or other potentially hazardous substances.

- **Closed-toe Shoes:**

Wear closed-toe shoes to protect your feet from spills and accidents.

- **Hair and Clothing:**

Tie back long hair and wear long pants or skirts to avoid entanglement or exposure to hazards.

2. Following Instructions and Procedures:

- **Read and Understand:**

Carefully read and understand all instructions and procedures before starting any experiment or procedure.

- **Follow Instructions:**

Strictly adhere to all instructions and procedures, including those related to handling chemicals, equipment, and disposal of waste.

- **Ask Questions:**

If you are unsure about any aspect of a procedure, ask your supervisor or instructor for clarification.

3. Safety Equipment and Procedures:

- **Know Location:**

Familiarize yourself with the location of safety equipment, such as eyewash stations, fire extinguishers, first-aid kits, and emergency exits.

- **Proper Use:**

Know how to use safety equipment correctly and promptly in case of an emergency.

- **Unattended Experiments:**

Never leave experiments unattended.

- **Proper Waste Disposal:**

Dispose of all chemicals and biological materials properly according to established procedures.

4. General Lab Practices:

- **No Food or Drink:** Do not eat, drink, or chew gum in the laboratory.
- **Hand Hygiene:** Wash your hands thoroughly before and after working in the laboratory, especially before leaving the lab.
- **Cleanliness:** Maintain a clean and organized workspace to prevent accidents and spills.
- **Report Incidents:** Report any accidents, spills, or near-miss incidents to your supervisor immediately.

- **Safety First:** Always prioritize safety in the laboratory and never take shortcuts or engage in risky behaviours.

Diamond Drill Casing

Casing

Diamond drill casing is employed in fractured, fissured, or porous rock formations to prevent caving material from entering the drill hole, avoid loss of drilling fluid, or seal off excessive inflows of water, mud, or sand. In relatively light overburden, casing may be driven down with a drive hammer or drilled down using a diamond or tungsten carbide set casing bit or shoe. When drilling on bedrock setups, a short length of casing is drilled into the rock to prevent entry of surface debris into the hole and facilitate collection of sludge or return water. Diamond drill casing is available in two types: flush jointed and flush coupled. The flush outside wall of diamond drilling casing greatly aids its advance or withdrawal from the hole.

Flush Coupled Casing

This type has a box thread at both ends and is connected by a pin-to-pin coupling. The inside diameter of the casing is larger than the inside diameter of the coupling to reduce its weight. One coupling is supplied with each length. When measuring the length of a section of flush-coupled casing, the body of the casing is included but not the projecting pin thread of the coupling. The length of a section of flush joint casing is determined by measuring the casing without including the projecting pin thread.

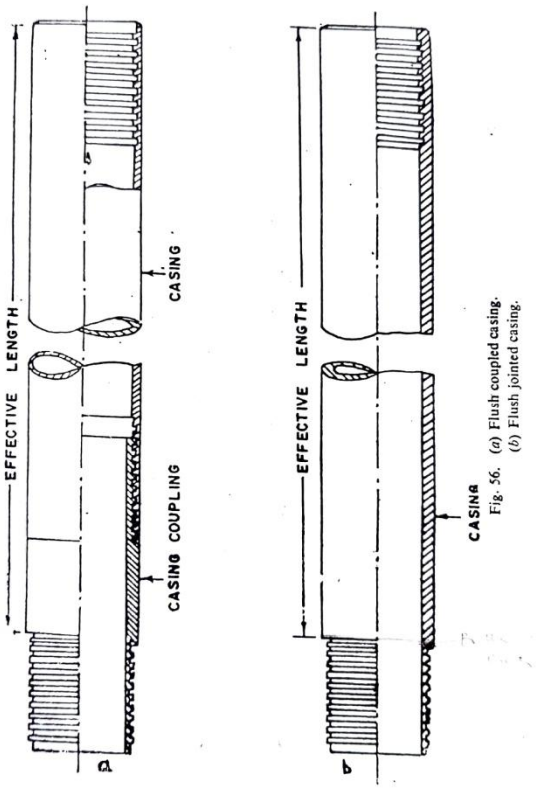


Fig. 56. (a) Flush coupled casing. (b) Flush jointed casing.

Flush Jointed Casing

This type has a heavier wall than coupled casing and makes up flush on the inside and outside diameters. It has an integral pin and box thread of the same dimensions as coupled casing, thus the two are interchangeable. Because of its heavier wall, there are both internal and external mating shoulders against which the threaded section butts. This provides twice the contact area of flush coupled casing to prevent the threads from climbing under heavy torque loads.

It is important to understand the nesting principle of casing; i.e., any size casing will fit into the next larger size, and it can pass the corresponding size core bit and reamer shell. For example, AX casing will pass EX casing and AX equipment. Nested strings of casings of the X series group are shown in this figure. Any combination of this nesting can be used in ordinary drilling where two or more strings of casing are required. Both types of casing are made of steel tubing. Careful workmanship and rigid inspection ensure proper fitting threads for interchangeability and easy make-up and breaking out casing strings. All casings and couplings are supplied with right-hand threads. Left-hand thread casings are furnished on special order by the suppliers. The casings are supplied in 1', 2', 3', 5', 10' (0.30 m, 0.61 m, 0.91 m, 1.5m and 3m) lengths. Equipment commonly used or associated with casing, such as the pilot reamer, stuffing box, underreamer, and casing cutter, are discussed below.

Pilot Reamer

The pilot reamer reams out drill holes to set casing. The assembly, consisting of a pilot coupling, casing bit, casing, and casing-to-rod sub, is attached ahead of a string of rods. The pilot guides the casing bit and prevents deviation from the original hole. The casing bit does the actual reaming with feed and rotation applied as in drilling. The pilot reamer is most effective in ground that caves badly; the hole is apt to be lost when the string is pulled to remove the reamer. The hole must then be recovered using a diamond casing shoe.

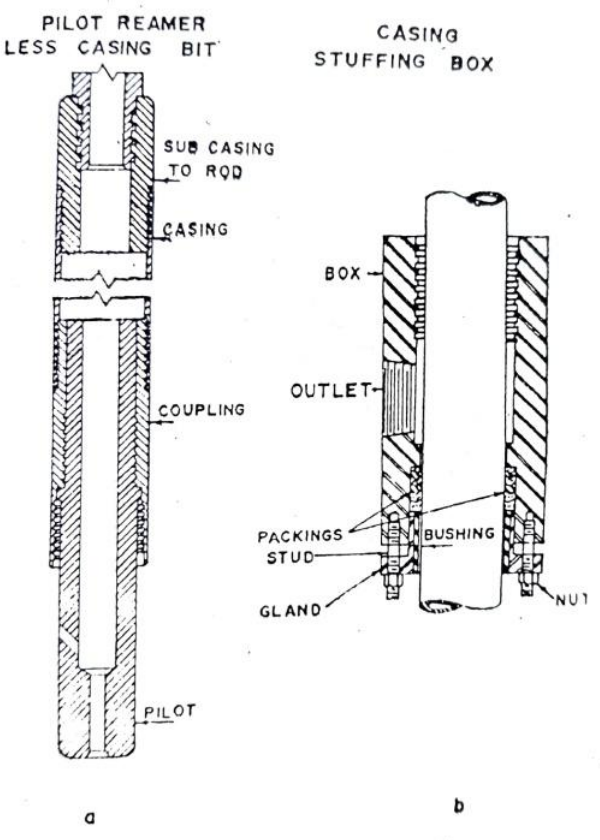


Fig. 60. (*a*) Pilot reamer less casing bit. (*b*) Casing stuffing box.

Casing Stuffing Box

The casing stuffing box is used for underground drilling and for controlling gas-artesian pressure flows in surface drilling. It controls the drilling fluid's return from the hole to prevent spilling on the driller, his working area, or equipment. The stuffing box is screwed into the casing coupling. Its 'V'-shaped packings seal the rods by tightening the nuts and forcing in the packing gland. The outlet on the side of the stuffing box is threaded for pipe fittings that return the water to the sump. For underground operation, about 1.5 meters of casing or pipe must be set in the hole with only the threads of the casing coupling (or pin threads of flush jointed casing) protruding for mounting the stuffing box.

Underreamer

The underreamer is a specialized tool designed to ream out a drill hole under or below a string of casing that is in the hole. The following two conditions may necessitate the use of an under reamer:

- The line of casing in the hole must be extended and cannot be withdrawn due to wall conditions existing between the top of the hole and the bottom of the casing.

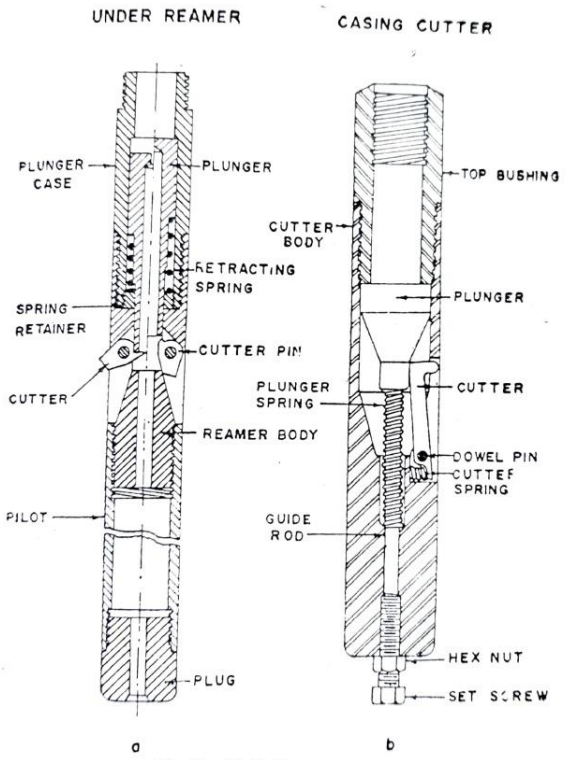


Fig. 61. (*a*) Under reamer. (*b*) Casing cutter.

- It is not desirable or practical to reduce the size of the hole by inserting another string of the next smaller size casing.

The use of an underreamer is only recommended when other means of completing the hole have proven unsatisfactory. The underreamer is constructed to fasten to a core barrel by connecting it to the bit end of the reamer shell. The pressure applied by the circulating water forces the piston downward to engage a shoulder on the cutters, causing them to pivot out against the wall of the hole or into a reaming position. When the pressure is released, the spring forces the piston up and allows the cutters to retract into a recess in the body of the reamer, so it can be withdrawn from the hole. Underreamers come with tool steel cutters for soft ground or diamond-set cutters for hard rock.

Casing Cutter

When a line of casing is stuck in a drill hole, a portion of it can be salvaged by cutting the casing with a special tool known as a casing cutter. By using this tool, the casing can be cut at any desired point in the string. The casing cutter connects directly to the drill rods, and the pressure of the circulating water forces a piston downward, which in turn forces the tool steel cutter out against the casing, similar to a cutting bit on a lathe machine. After the casing is cut, the pressure is released, and the retracting spring then forces the piston up and the cutter spring causes the cutter to retract. The adjustable screw at the bottom of the casing cutter sets the travel of the cutter. A jam nut prevents unwanted movement of the screw.

Jarring and Stand Pipe Equipment

This equipment is commonly used for penetrating overburden with standpipe or casing. It includes a drive hammer or jar weight, drive head, pipe shoe, drive pipe, etc. The figure shows some of the items commonly used in jarring or driving standpipe or casing. The jar weight is available as one piece or as a sectional jar weight. A sectional jar weight assembly consists of one or more upper jar weight sections, one lower jar weight section, bolts, and a chain assembly to fit the number of sections required depending on the weight needed to drive or jar up the standpipe.

The drive head transmits the force of the blow of a jar weight to the standpipe or casing. A pipe shoe or drive shoe is used at the bottom of the drive pipe or casing to protect the end of the pipe or casing when driving. The end of the shoe is bevelled to provide a cutting edge and also permits seating of the shoe in bedrock when desired. The drive pipe used in diamond core drilling is of a heavy-duty type, has standard male pipe threads on both ends, and is coupled with a heavy-duty recessed

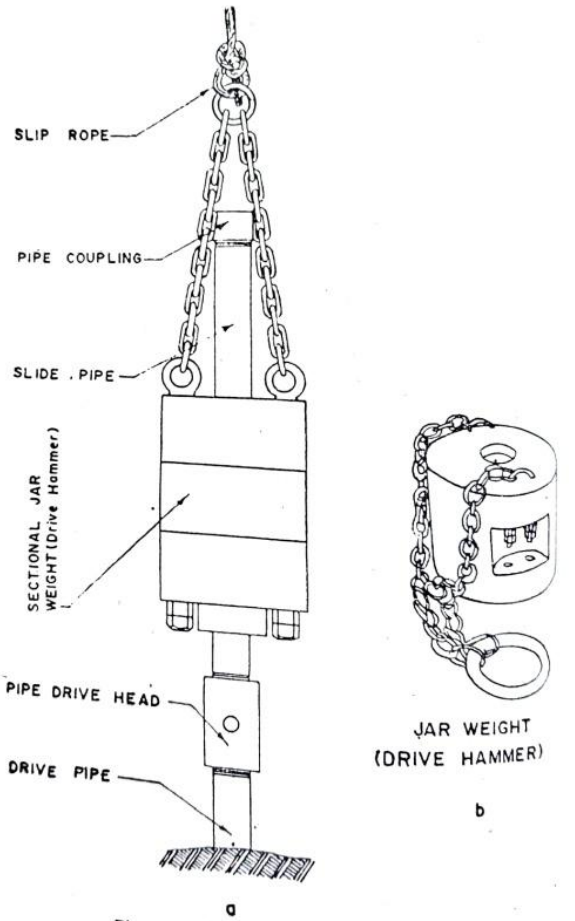


Fig. 62. (*a*)-Jarring and stand pipe equipment. (*b*) Jar weight (Drive hammer).

pipe coupling. The major factor to consider when selecting drive pipe is the I.D. of the pipe, which must be large enough to pass all the tools that may subsequently need to go into the hole. While executing core drilling operations, a 102 mm (4") diameter drive pipe has been found ideally suitable. It can be set either by drilling a pilot hole with a tricone bit or by driving it with a drive hammer and jar staff. This size facilitates the insertion of NX casing equipped with a casing bit, casing shoe, or drive shoe followed by other telescoping sizes of casings or coring equipment. The drive pipe should be kept available on the drill site in 3-meter (10') lengths with a few lengths of 0.30 m, 0.61 m, 0.91 m, 1.5 m (2', 3' & 5') for convenience in driving operations.

Straight and cross-chopping bits are used to clear the material gathered in the drive pipe for advancing by connecting either of them with drill rods and a water swivel. Fish tail bits are generally used for drilling through overburden or soft formations free of boulders. Various shapes of fish tail bits are used depending on the specific requirements.

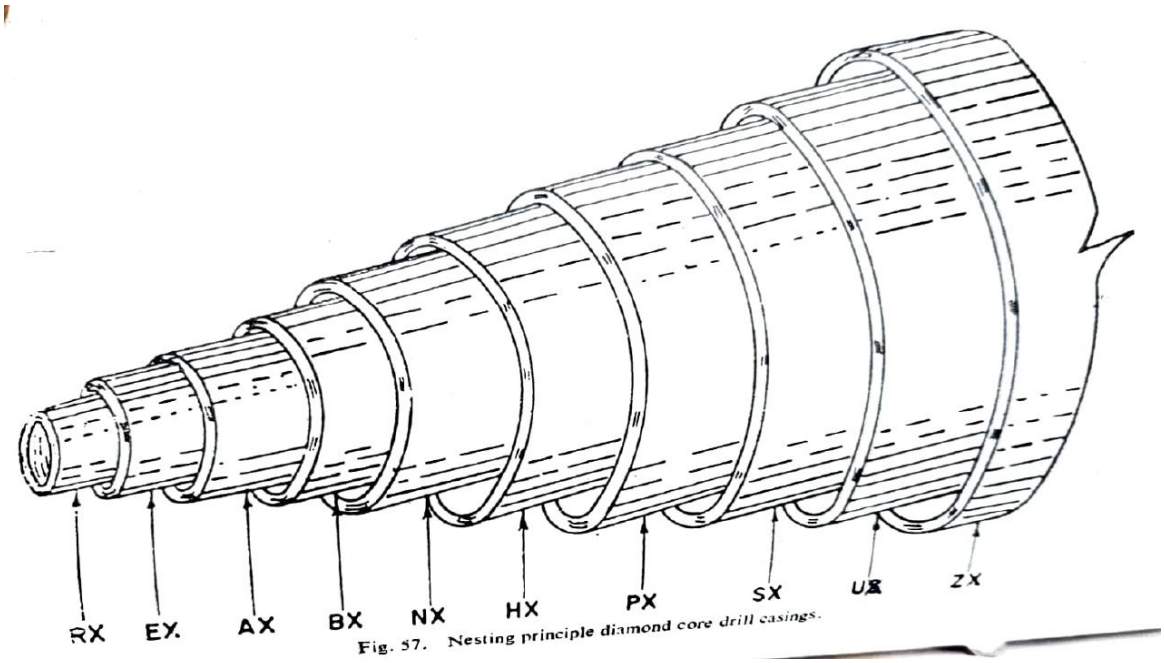
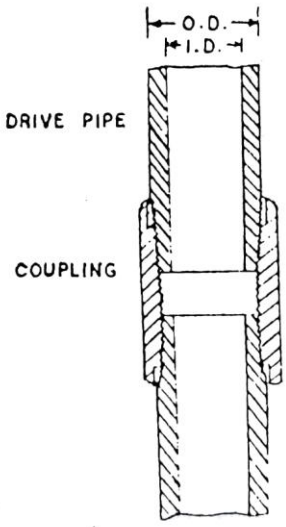


Fig. 57. Nesting principle diamond core drill casings.

DRIVE SHOE

a

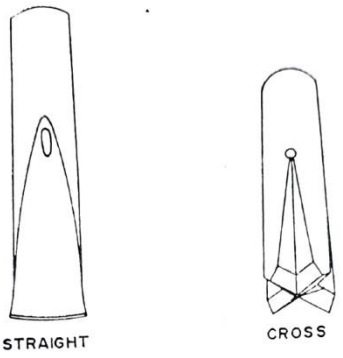


DRIVE PIPE AND COUPLIN

b

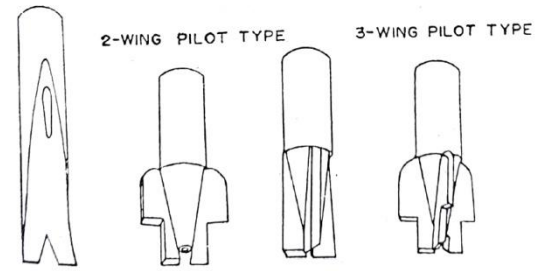
Fig. 63. (*a*) Drive shoe.
(*b*) Drive pipe and coupling.

CHOPPING BITS



a b

FISHTAIL BITS



c d e f

Fig. 64. Chopping bits
(*a*) Straight
(*b*) Cross
Fish tail bits
(*c*) 2-wing pilot
(*d*) 2-wing pilot type
(*e*) 3-wing type
(*f*) 3-wing pilot.

Experiment No.1:- Casing

Aim of the Experiment: To understand the principles, types, applications, and associated equipment used in diamond drill casing as described in the provided document. This guide will familiarize you with the terminology and functionality of these essential components in drilling operations.

Apparatus Required:

- Document on Diamond Drill Casing.
- Diagrams or actual samples of different casing types and equipment.
- Worksheet for note-taking and answering questions.

Procedure:

Part 1: Introduction to Diamond Drill Casing (Read the first paragraph)

1. **Define:** In your own words, explain the primary purpose of using diamond drill casing in drilling operations.
2. **Identify:** List the specific geological conditions where diamond drill casing is typically employed.
3. **Describe:** Briefly outline the two methods mentioned for advancing casing in relatively light overburden and bedrock setups.

Part 2: Types of Diamond Drill Casing (Read the sections on "Flush Coupled Casing" and "Flush Jointed Casing")

1. **Compare and Contrast:** Create a table summarizing the key differences between flush coupled and flush jointed casing based on the following criteria:
    - Thread type and connection method
    - Inside diameter characteristics
    - Wall thickness
    - Internal and external flushness
    - Contact area for torque resistance
    - Interchangeability
    - Measurement of length
2. **Sketch:** Draw a simple cross-sectional diagram of both flush coupled and flush jointed casing, highlighting the key features discussed in the text.
3. **Explain:** What is the "nesting principle" of casing? Provide the example given in the text (AX and EX casing) to illustrate this principle.
4. **Discuss:** How does the nesting principle benefit drilling operations where multiple casing strings are required?
5. **Note:** What material are both types of casing made from? What quality control measures are mentioned? What is the standard thread direction, and how can left-hand threads be obtained?
6. **List:** What are the standard lengths in which casings are supplied (both imperial and metric units)?

Part 3: Associated Equipment (Read the sections on "Pilot Reamer," "Casing Stuffing Box," "Underreamer," and "Casing Cutter")

For each piece of equipment listed below, answer the following questions:

- **Name of Equipment:**
- **Primary Function:**
- **Key Components/Assembly:** (Briefly describe how it is constructed or assembled)
- **Operational Principle:** (How does it work?)
- **Specific Applications/Situations for Use:**
    - **Pilot Reamer**
    - **Casing Stuffing Box**
    - **Underreamer**
    - **Casing Cutter**

Part 4: Jarring and Stand Pipe Equipment (Read the section on "Jarring and Stand Pipe Equipment")

1. **Purpose:** What is the main application of jarring and standpipe equipment?
2. **Identify:** List the key components of this equipment mentioned in the text.
3. **Describe:** Briefly explain the function of the following components:
    - Jar weight (including sectional type)
    - Drive head
    - Pipe shoe/Drive shoe
    - Drive pipe
4. **Importance of I.D.:** Why is the inside diameter (I.D.) of the drive pipe a critical factor in its selection? What is the ideally suitable diameter mentioned for core drilling operations?
5. **Setting Methods:** What are the two methods mentioned for setting the 102 mm (4") diameter drive pipe?
6. **Standard Lengths:** What are the recommended lengths for drive pipe to be kept on-site?
7. **Material Removal:** Describe the types of bits used to clear material from the drive pipe for advancement. What are fish tail bits generally used for?

Part 5: Review and Discussion

1. Review your notes and answers from the previous sections.
2. Be prepared to discuss the following questions:
    - Why is it important to use the correct type of casing for different geological formations?
    - How does the associated equipment contribute to efficient and effective casing operations?
    - What potential problems can arise during casing operations, and how might the described equipment help address them?
    - Based on the descriptions, can you think of any safety considerations related to handling and using diamond drill casing and its associated equipment?

Conclusion:-

From the above experiment, I am able to differentiate different casings, their application and associated equipment used in driving casing.

Assessment:

Your understanding of the material will be assessed based on the completeness and accuracy of your answers in the worksheet and your participation in the review and discussion session.

Safety Precautions (General - Refer to specific operational manuals for detailed safety procedures):

- Always handle casing and equipment with appropriate personal protective equipment (PPE), including gloves and safety footwear.
- Ensure all connections are properly made and tightened to prevent failures.
- Be aware of the weight and potential for movement of casing and associated tools.
- Follow established procedures for lifting, handling, and operating all equipment.

This laboratory guide is intended to provide a structured approach to understanding the information presented in the provided document. Remember to read the text carefully and refer back to it as needed to answer the questions thoroughly.

Experiment No.2:- Fishing Tool

Aim of the Experiment: To identify fishing tool and summarize its application.

Apparatus Required: Different Fishing Tools

Theory:
Fishing tools are essential in the drilling industry for recovering lost or stuck drilling equipment. Fishing tools are designed to address various challenges encountered during drilling operations. They are constructed from high-quality steel and are often compatible with all sizes of drilling tools. Most tools come with left- or right-hand threads to match corresponding drill rods or casings.

Female Rod Tap
Description: Bevelled edges and tapered threads.
Usage: When the fish is a rod pointing upwards.

Female Rod Coupling Tap
Description: Similar to female rod tap.
Usage: When the fish's top is a coupling pin facing upwards.

Male Rod Tap
Description: Deployed when a rod has twisted off.
Usage: When the rod flares out and bites into the hole's wall.

Rod Coupling Tap
Description: Most effective when the fish's top is a coupling pin facing up.
Usage: Under similar conditions as male rod tap.

Rod or Coupling Spear
Description: Friction grip tool.
Usage: Alternative when taps fail.

Casing Recovery Tap
Description: Highly effective, casing usually fills the hole.
Usage: Similar to other male taps.

Bit and Shell Recovery Tool
Description: Designed to drill through and past the lost item.
Usage: When conventional recovery taps struggle.

Drive Pipe Retriever
Description: Alternative method for recovering drive pipes.
Usage: Run down inside the top section of the pipe.

Rose Bit
Description: Resembles and functions like a milling machine cutter.
Usage: Mills away any metallic object in the hole.

Core Picker
Description: Recovers loose core accidentally left in a drill hole.
Usage: Screws into the end of core barrel outer tube.

Magnetic Extractor
Description: Removes small pieces of tramp iron.
Usage: Not designed for actual recovery of lost drill tools.

Jar Collars
Description: Used in conjunction with Jar.

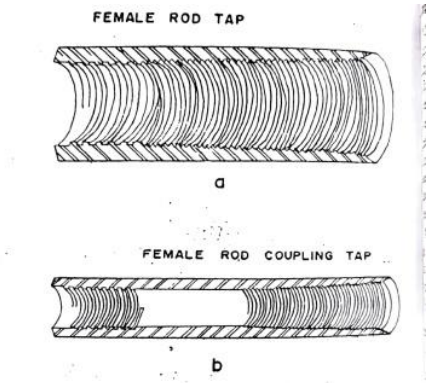


Fig. 129. Female and male rod and coupling taps
(a) Female rod tap
(b) Female rod coupling tap

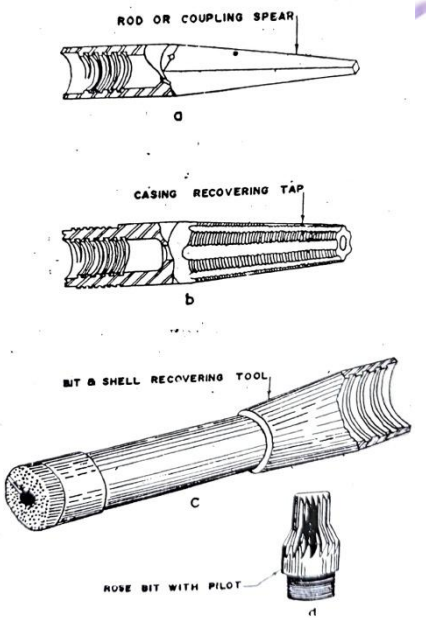


Fig. 130. (a) Rod or coupling spear
(b) Casing recovering tap
(c) Bit and shell recovering tool
(d) Rose bit with pilot.

Usage: For loosening stuck or jarring casing upwards.

Rod Jar Weights

Description: Used to free drill rods stuck in a drill hole.

Usage: Worked by hand or slip rope drum.

Hydraulic Casing and Rod Puller

Description: Recovers tight or stuck drill rods, casing or pipe.

Usage: When pull required exceeds the capacity of drill hoist.

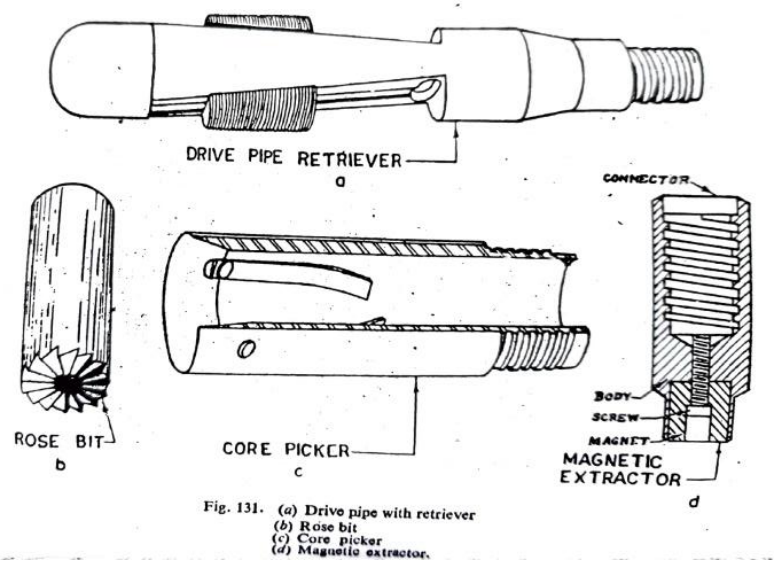


Fig. 131. (a) Drive pipe with retriever
(b) Rose bit
(c) Core picker
(d) Magnetic extractor.

Best Practices for Using Fishing Tools

1. Assess the Situation

Determine the type of fish and its position before selecting a tool.

2. Choose the Right Tool

Select a tool compatible with the size and type of the drill rod or casing.

3. Use Proper Techniques

Follow specific procedures for each tool to ensure safety and effectiveness.

4. Monitor Condition

Regularly inspect tools for wear and damage to maintain performance.

5. Utilize Custom Tools for Emergencies

In cases where standard tools fail, bespoke tools may be necessary for specific challenges.

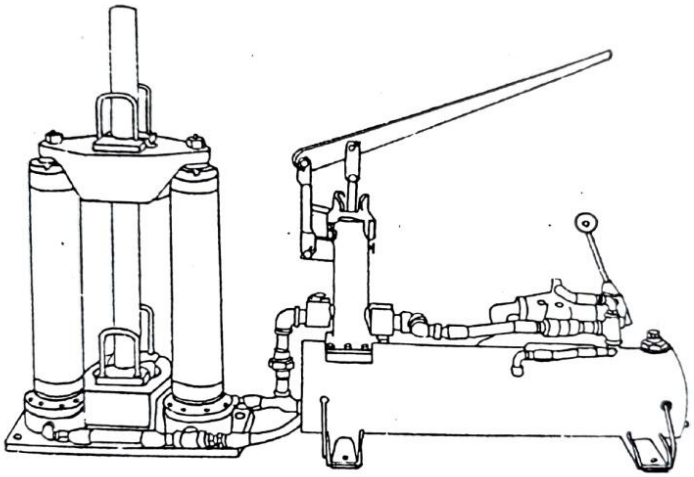


Fig. 133. Hydraulic casing and rod puller with hand pump and pressure tank unit.

Conclusion:-

By understanding and effectively using these fishing tools, driller can significantly improve the efficiency and success of their drilling and fishing operations.

Experiment No.3:- Fishing Procedure in Diamond Core Drilling

Aim of the Experiment: Identify fishing due to twist off and Perform fishing operation appropriately.

Apparatus Required:- Appropriate Fishing Tools, Pipe wrench, Chain Tonge, Measuring Tape.

Theory:-

Obstacles reason due to equipment stuck in the borehole or falling of object in the borehole and if it is not recovered easily which prevent further advance of the bore hole is called “Fish”. The operation to clear the bore hole for further drilling is called “Fishing” and the tools employed for fishing operation are called “Fishing Tools”.

Procedure:-

Below is the step-by-step procedure to be followed to carry out successful fishing operation.

Immediate Response

Stop rotation and feed immediately to prevent further damage to the fish.

Measure the rod length above ground.

String Retraction

As the string is retracted, maintain exact records of its length.

This allows for the determination of the fish's depth, which is crucial for successful fishing.

Examination of Equipment

Conduct a careful examination of the bottom of the string.

Identify the equipment pointing upward in the hole and assess its condition.

This evaluation will guide the selection of the appropriate fishing tool.

Wax Impression

If possible, obtain a wax impression on the top of the fish.

This aids in visualizing the fish's condition, position relative to the hole wall, and the complexity of the job.

Use of Fishing Tools

Left Hand Rods:

Generally used for extracting rods or casings stuck in the hole.

Recovery is usually achieved by backing off the line of tools.

Right Hand Threaded Rods:

Can sometimes be used with left hand fishing tools.

Apply melted resin to each coupling and heat the rod threads with a blow torch before assembly.This method secures the rod joint tight when turned counterclockwise.

Handling Taps with Right Hand Threads

If using a tap with right hand threads, ensure the fish can be pulled out easily.

If the fish is stuck, disengaging the tap may become complicated.

Consider using a friction hold with a spear whenever practical to facilitate disengagement.

Extraction Procedures

If the fish is free in the drill hole, proceed with retraction using fishing tools.

If the fish is jammed, reaming of the hole is necessary to free the fish.
During reaming, take measures to prevent deviation from the hole.

Avoiding Jamming

Conduct a thorough study of the formation to encase the hole at succeeding depths while drilling.
If the drill string is stuck due to wedging from fallen pieces, use effective washing of the hole combined with rotation and jarring of the rod string to free the jam.

Conclusion

Following this SOP will ensure safe and efficient drilling operations using the electric heater drill, contributing to successful projects involving basalt and granite drilling. Always adhere to safety standards and report any abnormalities to the supervising personnel.

Experiment No.4:- Starting of Diesel Engine

Aim Of the Experiment: To practice how to start Diesel engine and documentation issues, if any during its operation.

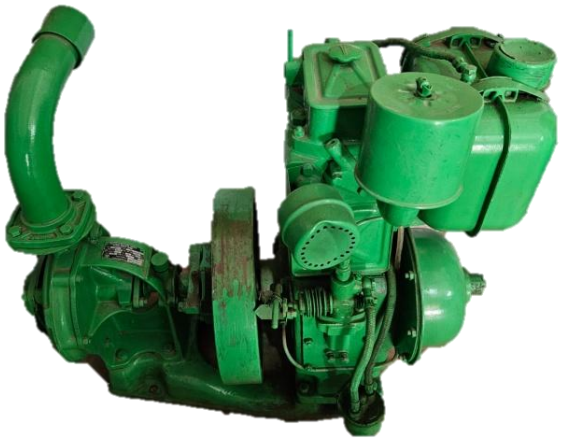
Equipment Required:

Personal Protective Equipment (PPE) (gloves, goggles, etc.)
Fuel (Diesel)
Engine manual
Fire extinguisher (accessible)

Theory:-

A diesel engine is a type of internal combustion engine that ignites fuel (diesel) by compressing air to a high temperature, rather than using a spark plug like gasoline engines.
Here's a more detailed explanation about diesel engine:

- How it works:
  - Air is drawn into the cylinders and compressed, raising its temperature significantly.
  - Diesel fuel is then injected into the hot, compressed air, causing it to ignite spontaneously.
  - The combustion of the fuel pushes the piston, which in turn rotates the crankshaft, generating power.



- Key Features:
  - Compression Ignition: Diesel engines rely on the heat generated by compressing air to ignite the fuel, hence the term "compression ignition".
  - No Spark Plugs: Unlike gasoline engines, diesel engines do not use spark plugs to ignite the fuel.
  - High Compression Ratios: Diesel engines typically have higher compression ratios than gasoline engines.
  - Fuel Injection: Diesel fuel is injected directly into the cylinders, often using a high-pressure fuel injection system.
- Advantages:
  - Fuel Efficiency: Diesel engines are generally more fuel-efficient than gasoline engines.
  - Torque: Diesel engines produce high torque, making them suitable for Drill rig.

Procedure:-

1. Pre-Start Checks

Safety Gear: Ensure that all necessary personal protective equipment (PPE) is worn, such as gloves, goggles, and ear protection.
Inspection:

Check the engine oil level.
Inspect coolant levels.

Ensure fuel levels are adequate.
Look for any signs of leaks or damage.
Cleanliness: Remove any debris or obstructions from the engine area.

2. Starting the Engine

Fuel Supply: Ensure that the fuel supply valve is open.
Switches:
Confirm that all electrical switches are in the off position.
Set the ignition switch to the "on" position.
Pre-Heating: If the engine is equipped with a pre-heat system, activate it according to the manufacturer's instructions.
Start Engine:
Turn the ignition key to the "start" position.
Release the key once the engine starts.
If the engine does not start after a few attempts, check for issues before retrying.

3. Post-Start Checks

Monitor Gauges: Observe the engine's oil pressure, temperature, and RPM gauges to ensure they are within normal operating ranges.
Listen for Unusual Noises: Pay attention to the sound of the engine for any irregularities.
Check for Leaks: Inspect the area around the engine for any signs of fuel, oil, or coolant leaks.

4. Emergency Procedures

If the engine does not start after several attempts, consult the troubleshooting guide specific to the engine model.
In case of a fire or smoke, immediately shut down the engine and activate fire suppression systems if available.
Always have a fire extinguisher accessible in the vicinity of the engine.

Documentation

Record any issues encountered during the starting process in the maintenance log.
Report any ongoing issues to the maintenance personnel for further inspection.

Conclusion

Following this SOP ensures that the diesel engine is started safely and efficiently, minimizing the risk of accidents and mechanical failures. Always adhere to manufacturer guidelines while operating diesel engines.

Experiment No.5:- Starting of Petrol Engine

Aim Of the Experiment: To practice how to start Petrol engine and documentation issues, if any during its operation.

Equipment Required:

Personal Protective Equipment (PPE) (gloves, goggles, etc.)
Fuel (petrol)
Engine manual
Fire extinguisher (accessible)

Theory:-

A petrol engine, also known as a gasoline engine, is an internal combustion engine that uses spark ignition to combust a fuel-air mixture, typically gasoline, to generate power.

Here's a more detailed breakdown:

Key Characteristics:

Internal Combustion:

Petrol engines burn fuel within the engine's cylinders, converting chemical energy into mechanical energy.

Spark Ignition:

Unlike diesel engines, petrol engines use a spark plug to ignite the fuel-air mixture.

Four-Stroke Cycle (Common):

The most common type of petrol engine operates on a four-stroke cycle: intake, compression, combustion (power), and exhaust.

Two-Stroke Cycle (Less Common):

Some petrol engines, like those used in smaller applications, operate on a two-stroke cycle, completing the cycle in one revolution of the crankshaft.

Lower Compression Ratio:

Petrol engines typically have a lower compression ratio compared to diesel engines.

Fuel:

Petrol engines are designed to run on gasoline (petrol) but can often be adapted to run on other fuels like LPG or ethanol blends.

How it Works (Four-Stroke Cycle):

Intake: The piston moves down, drawing a mixture of air and fuel into the cylinder.
Compression: The piston moves up, compressing the air-fuel mixture.
Combustion (Power): A spark plug ignites the compressed mixture, causing it to expand and push the piston down, generating power.
Exhaust: The piston moves up again, pushing the burnt gases out of the cylinder.

Types of Petrol Engines:

Naturally Aspirated: These engines draw in air and fuel naturally, without any forced induction.
Turbocharged: These engines use a turbocharger to force more air into the cylinders, increasing power output.
Direct Injection (GDI): These engines inject fuel directly into the cylinders, improving efficiency and power.
Multi-point Fuel Injection (MPFI): Fuel is injected into the intake manifold, near the intake valves.

Engine Size:

Engine size is measured in liters or cubic centimeters (cc) and refers to the total volume of the cylinders.

Applications:

Petrol engines are commonly light weight and generates less torque than diesel engine. So used in less powered drill rigs as well as portable drill rigs.

Procedure:-

1. Preparation

Ensure you are wearing appropriate PPE.

Check the area around the engine for any hazards (flammable materials, obstructions, etc.).

Make sure the engine is on a stable surface.

2. Fuel Check

Verify that the petrol tank is filled to an appropriate level.

Check for any fuel leaks or signs of damage.

3. Inspection

Inspect the engine for any visible damage or loose connections.

Ensure that the oil level is adequate.

4. Safety Checks

Confirm that the area is well-ventilated to avoid inhaling fumes.

Ensure that the engine's kill switch is in the 'off' position.

Have a fire extinguisher nearby and know how to use it.

5. Starting the Engine

Turn the fuel valve to the 'on' position (if applicable).

Set the choke to the 'closed' position for cold starts (if applicable).

Insert the key into the ignition and turn it to the 'start' position or press the start button.

If the engine does not start within a few seconds, release the key/button and wait for a moment before trying again.

6. After Starting

Once the engine starts, adjust the choke to the 'open' position (if applicable).

Allow the engine to warm up for a few minutes before operating at full load.

Monitor the engine for any unusual noises or vibrations.

7. Shutdown Procedure

To turn off the engine, switch the kill switch to the 'off' position.

Allow the engine to cool down before performing any maintenance or inspections.

Emergency Procedures

In case of fire, immediately use the fire extinguisher and call for help.

If the engine shows signs of malfunction, turn it off and report the issue to a supervisor.

Documentation

Record the date, time, and any issues encountered during the startup in the maintenance log.

Conclusion:-

Following this SOP ensures that the petrol engine is started safely and efficiently, minimizing the risk of accidents and mechanical failures. Always adhere to manufacturer guidelines while operating petrol engines.

Experiment No.6:- Running of Electric Motors

Aim Of the Experiment: To practice how to run Electric Motors safely, ensure efficiency and prevent accidents. and documentation issues, if any during its operation.

Equipment Required:

Personal Protective Equipment (PPE) (gloves, goggles, etc.)
Electric Motor
Motor manual
Fire extinguisher (accessible)

Theory:-

An electric motor converts electrical energy into mechanical energy, typically through the interaction of magnetic fields and current-carrying conductors, and is classified by the type of current it uses (AC or DC) and its specific design.

Basic Function and Principle:

- Conversion: Electric motors are devices that transform electrical energy into mechanical energy, the opposite of an electric generator.
- Electromagnetism: They operate based on the principle of electromagnetism, where a force is generated when an electric current interacts with a magnetic field.
- Key Components:
    - Rotor: The rotating part of the motor, often containing magnets or electromagnets.
    - Stator: The stationary part of the motor, typically containing coils that create a magnetic field.
    - Magnetic Circuit: The rotor and stator together form a magnetic circuit, where the magnets create a magnetic field that interacts with the armature.
    - Armature: A part of the motor (either on the rotor or stator) that carries current and interacts with the magnetic field, generating torque.
- Torque Generation:
  Most electric motors develop mechanical torque through the interaction of conductors carrying current in a direction perpendicular to a magnetic field.

Types of Electric Motors:

- AC Motors:
    - Synchronous Motors: These motors maintain a constant speed, regardless of the load, making them suitable for applications requiring precise and constant speed, like clocks and timers.
    - Induction Motors: The most common type of AC motor, they rely on electromagnetic induction, are robust and reliable, and come in single-phase and three-phase varieties.

- DC Motors:
    - DC motors: are electrical motors that convert direct current (DC) electrical energy into mechanical energy.
    - Commutators and Brushes: DC motors often use commutators and brushes to periodically change the direction of the current in a part of the motor to facilitate continuous rotation.
- Special Purpose Motors:
    - Stepper Motors: These motors move in discrete steps, making them suitable for applications requiring precise positioning, like in printers and robotics.
    - Brushless DC Motors (BLDC): These motors use electronic commutation instead of mechanical commutators, offering higher efficiency and reliability.
- Other Types:
    - Universal Motors: These motors can operate on both AC and DC power and are commonly used in portable appliances and power tools.

Applications:

Electric motors are used in a wide range of applications, in drill rig in hoisting, rotating system and also in circulating pumps.

Procedure:-

1. Pre-Operation Checks

Inspect the electric motor for any visible damages or wear.
Ensure proper electrical connections are secure and free of corrosion.
Verify that all safety guards and covers are in place.
Check oil levels and lubrication where applicable.

2. Safety Precautions

Wear appropriate personal protective equipment (PPE) including gloves, goggles, and hearing protection.
Ensure that emergency shut-off switches are accessible and functioning.
Familiarize yourself with the emergency procedures in case of malfunction.

3. Starting the Electric Motor

Confirm that the area around the motor is clear of personnel and obstacles.
Turn on the main power supply to the motor.
Use the designated start button or switch to initiate motor operation.
Monitor the motor for any unusual sounds or vibrations during startup.

4. Operating the Electric Motor

Maintain awareness of the motor's performance, including temperature and sound.
Ensure that the motor is operating within its designated parameters (voltage, current, and load).
Do not overload the motor beyond its rated capacity.

5. Monitoring During Operation

Regularly check for any signs of overheating or abnormal operation.
Listen for unusual noises which may indicate mechanical failure.
Be prepared to stop the motor if any safety or operational issues arise.

6. Shutting Down the Electric Motor

Gradually reduce the load on the motor before shutting it down, if applicable.
Use the designated stop button or switch to turn off the motor.
Turn off the main power supply once the motor has come to a complete stop.
Allow the motor to cool down before conducting any maintenance or inspection.

7. Post-Operation Checks

Inspect the motor for any signs of wear or damage after operation.
Document any irregularities or maintenance needs noted during operation.
Ensure that the area is clean and free from debris.

Conclusion:-

Following this SOP ensures that the petrol engine is started safely and efficiently, minimizing the risk of accidents and mechanical failures. Always adhere to manufacturer guidelines while operating petrol engines.

Experiment No.7:- Centrifugal Pump

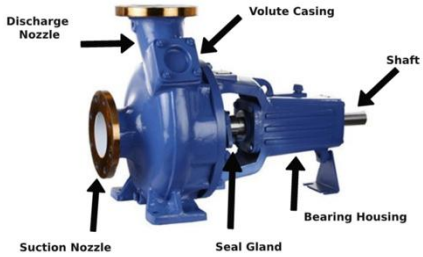
Aim of the Experiment:- Overhauling and maintenance of Reciprocating pump.

Apparatus Required:-

i. Centrifugal pump
ii. Hand tools
iii. Spare parts

Theory:-

Centrifugal pump converts mechanical energy into kinetic energy. The kinetic energy is then transferred to the displaced liquid. The liquid to be pumped enters the pump via the suction nozzle. From here, it reaches the centre of the impeller. The impeller spins the liquid tangentially. This generates a radial centrifugal force that acts outwards. The curved blades create low pressure in the centre of the impeller, allowing more fluid to be drawn from the impeller's suction end. The centrifugal force expels the liquid from the discharge nozzle.



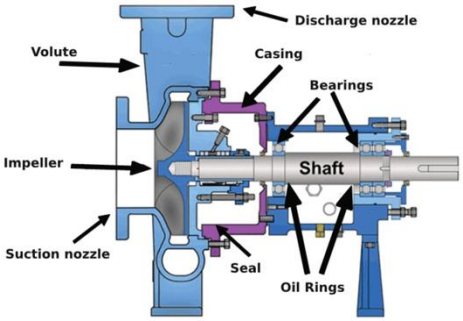
A centrifugal pump is comprised of two main components:

Rotating Part:

Impeller
Shaft
Volute

Stationary Component:

Bearings
Casing
Casing Cover



Operation of a Centrifugal Pump

The operation of a centrifugal pump involves the conversion of mechanical energy into kinetic energy, which is then transferred to the liquid being pumped. Here's how it works:

i. Liquid enters the pump through the suction nozzle.
ii. The liquid reaches the center of the impeller.
iii. The impeller spins the liquid tangentially.
iv. This motion generates radial centrifugal force acting outward.
v. The curved blades create low pressure in the center, drawing more fluid from the suction end.
vi. Centrifugal force expels the liquid through the discharge nozzle.

Starting a Centrifugal Pump Correctly

To ensure a centrifugal pump operates smoothly, follow these steps to start it:

i. Open the suction valve (suction nozzle).
ii. Keep the discharge valve (discharge nozzle) closed.
iii. Turn off the pump's power.
iv. Manually turn the shaft to check for obstructions.
v. If the shaft is free, close the discharge valve fully and start the motor.
vi. Gradually open the discharge nozzle until fully open.
vii. Check the pressure and regulate it with the bypass if necessary.

Overhauling a Centrifugal Pump: Step-by-Step Instructions

Before overhauling, ensure the pump is properly shut down:

i. Close the suction and discharge valves.

ii. Switch off the power and disconnect the pump from the main switch.
iii. Disconnect the electrical wire, noting the rotation direction for reconnection post-overhaul.
iv. Remove coupling bolts if present.
v. Remove the pump for inspection.

Dismantling, Inspecting, and Reassembling a Centrifugal Pump: Step-by-Step Instructions

i. Start from the impeller side. Loosen the washer and guide nut.
ii. Use a pulley to unscrew the impeller.
iii. Remove the mechanical seal on the impeller.
iv. Remove the lock ring/bearing guide pin behind the impeller.
v. Gently tap the shaft with a rubber or wooden hammer to remove the bearings.
vi. Inspect the bearings for wear. Replace if necessary.

Replacing Bearings

i. Clean the shaft thoroughly.
ii. Lubricate it and gently tap the back of the bearing groove.
iii. Clean and lubricate the bearing groove before installing new bearings.
iv. Install the new bearings as removed.
v. Clean the bearing housing and apply adequate grease.

Final Assembly

i. Install the shaft from the impeller's side.
ii. Install new mechanical seals if required.
iii. Reattach all removed washers and tighten nuts as necessary.
iv. Rotate the shaft to ensure free movement.
v. Check the alignment of the pump and box it.
vi. Mount the electric motor and connect the pump.
vii. Verify free movement before starting the pump.

Conclusion:-

Adhering to this standard operating procedure, ensure safe and effective overhauling and maintenance of centrifugal pump

Experiment No.6:- Maintenance of Reciprocating Pump

Aim of the Experiment :- Replace the Liner and Pistons of Reciprocating Pump

Apparatus Required:-

i. Spare parts of reciprocating pump.
ii. Hand Tools

Procedure:-

Before beginning any maintenance procedures, always vent the pump pressure

I. Removing the Discharge Valves

To safely remove the discharge valves of the reciprocating pump, follow these steps:

i. Unscrew the upper valve cover from the fluid end module. This also removes the valve stem guide, which is attached by a retaining plate.
ii. Remove the upper valve cover seal from the fluid bore.
iii. Lift the valve spring and discharge valve out of the bore, using a hook magnetic retrieval tool if necessary.
iv. Remove the discharge valve seat only if the valve is being replaced. Use a hydraulic seat puller to extract it carefully.

II. Removing the Suction Valves

The suction valves may be removed for replacement or routine maintenance. To gain access to the liner and piston assemblies, follow these steps:

i. Unscrew the forward valve cover plugs from the fluid end module.
ii. Remove the lower valve cover from the bore.
iii. Remove the lower valve cover seal from the fluid bore.
iv. Carefully remove the valve retainer from the valve bore.
v. Slide the valve cage out of the fluid bore, ensuring no damage to the valves.
vi. Carefully lift the valve spring and suction valve out of the bore, using a hook magnetic retrieval tool as needed.
vii. Remove the valve seat only if the valve is being replaced, following the same procedure as for the discharge valve seat.

III. Removing the Pistons & Liners

For the removal of pistons and liners from the MP-16, follow this procedure:

i. Unbolt and remove the clamps affixing the piston assemblies to the crosshead extension rods, leaving the piston rod in the forward-most position.
ii. Rotate the pump to bring the crosshead extension to the end of its suction stroke.
iii. Remove the O-Ring from the split ring holding the liner lock in place, then slide the split ring free of the liner.
iv. Unscrew the liner lock from the retainer flange and slide it free of the liner, taking care not to damage the liner or threads.
v. Remove the liner and piston rod assembly from the power frame.
vi. Remove the seal from the counter bore inside the liner retainer flange.

IV. Piston Disassembly & Parts Replacement

To disassemble and replace piston components, use the following steps:

i. Remove the piston rod nut and slide the piston hub off of the piston rod.
ii. Re-install the piston, ensuring the seal remains aligned with the groove in the piston hub. Lock in place with the piston rod nut, torquing to 1,000 ft. lbs.

V. Piston Cup Replacement

For replacing cups on older-style pistons with replaceable cups, follow these steps:

i. Remove the snap ring from the front of the hub and slide the piston cup free.
ii. To reinstall, slide the new cup onto the hub and secure with a snap ring.

VI. Installing the Suction Valves

To replace the suction valves, follow this procedure:

i. If removed, slide the valve seat into the bore and press with a seat driver for an initial seal.
ii. Slide the discharge valve into position atop the seat, then insert the spring atop the valve.
iii. Lightly grease the new valve cover seals and insert into the counter bores.
iv. Grease the bottom seating surface and outside of the valve covers, then screw into place.
v. Grease the bottom seating surface and outside of the valve cover locks, then screw into place.
vi. After reassembly, run the pump for approximately 15 minutes, shut it down, release the pressure, tighten the valve corner again, and resume pumping.

VII. Installing the Discharge Valves

Follow these steps for the installation of the reciprocating pump discharge valve:

i. If necessary, unscrew the upper valve cover from the fluid end module, which also removes the valve stem guide.
ii. If replacing, unbolt the retainer plate from the upper valve cover.
iii. Replace the upper valve stem guide and re-bolt the retainer plate into position.
iv. If removed, slide the valve seat into the bore and press with a seat driver for an initial seal.
v. Slide the discharge valve into position atop the seat, then insert the spring atop the valve.
vi. Set the covers atop the bore, ensuring proper alignment of the valve stem guide.
vii. Lightly grease the new valve cover seals and insert into place.
viii. Grease the bottom seating surface and outside of the valve covers, then screw into place.
ix. After reassembly, run the pump for approximately 15 minutes, shut it down, release the pressure, tighten the valve corner again, and resume pumping.

VIII. Installing the Pistons & Liners

To install the pistons, follow this procedure:

i. Install the O-Ring and wear plate into the counter bore of the fluid module.
ii. Insert the piston rod assembly into the liner and attach it to the inside of the retainer flange.
iii. Slide the liner lock into place around the liner, and screw into the retainer flange.
iv. Slide on the split ring to hold the gland in place and secure using a new O-Ring.
v. Rotate the pinion shaft to bring the extension rod and piston rod together, then install the piston rod clamps.

Conclusion:-

Able to summarize reciprocating pump and do maintenance work which hinders circulating fluid pressure.

Experiment No.7:- Drill Rig Operation

Aim of the Experiment :- To assemble all tool and equipment at drill site and perform drilling.

Apparatus Required:-

i. Drill Rig: Choose a suitable drill rig based on the project requirements and ground conditions.
ii. Drill rod: Choose Drill rod according to types of drilling.
iii. Casings: Select Casing according to requirement.
iv. Core Barrel: Select appropriate core barrel.
v. Drill Bit: Select appropriate drill bits based on the purpose, field of application.
vi. Water: Ensure an adequate water supply to the site for preparation of drilling fluid.
vii. PPE: Ensure all personal protective equipment for all crew.

Theory:-

Understanding Core Drilling

The drilling which is carried out to extract cylindrical samples of rock ,those called as core from the ground is called core drilling. These core samples are crucial for geological analysis, mineral exploration, and infrastructure development.

Key Terms

Core Sample: A cylindrical piece of rock or soil extracted during the drilling process.
Feed: additional pressure given to the bit to cut the rock.
Prestart Check-Up: Check engine oil, gear oil, coolant, lubrication of drill rig before starting.
Core barrel Retrieval: Removing the inner tube core from the core barrel to the ground.
Wireline: Process involved to retrieve the core with the help of overshot assembly.

Safety Measures

Safety is paramount in core drilling practices. Before starting of operation follow these safety guidelines:
- Personal Protective Equipment (PPE): Always wear appropriate PPE, including hard hats, gloves, safety glasses, and steel-toed boots.
- Site Assessment: Conduct a thorough assessment of the drilling site for potential hazards (e.g., unstable ground, underground utilities).
- Emergency Procedures: Familiarize yourself with emergency procedures and have first aid kits readily available.
- Equipment Inspection: Regularly do prestart check up of drill rig and check all equipment for defects or malfunctions before use.

Core Drilling Procedure

Follow these steps to execute a core drilling project effectively:
1) Site Preparation: Clear the area of debris and ensure accessibility for the drilling rig.
2) Positioning the Drill Rig: Set up the drill rig over the designated drilling point, ensuring it is stable and secure.
3) Drilling Fluid Preparation: Prepare drilling fluid mixing appropriate colloids to water ensuring density and viscosity.
4) Drilling: Begin drilling at a slow speed, gradually increasing as necessary. Monitor the drilling depth and core recovery.
5) Drive casing up to hard rock.
6) Core Retrieval: Once the desired length of drilling is reached, retrieve the core sample and inspect it for quality.
7) Repeat the process up to desired depth.
8) Documenting Results: Record all relevant data, including depth, core condition, and any geological observations.

Best Practices

To ensure efficiency and accuracy in core drilling, consider the following best practices:

- Regular Maintenance: Keep the drill rig and equipment well-maintained to avoid breakdowns.
- Training: Ensure that all personnel are adequately trained in core drilling techniques and safety protocols.
- Environmental Considerations: Be mindful of the environmental impact and adhere to local regulations regarding drilling activities.
- Continuous Monitoring: Keep track of drilling parameters and core recovery rates for ongoing performance evaluation.

Conclusion:-

Core drilling is an essential practice that requires careful planning and execution. By following this onboarding guide, you can ensure a safe and efficient core drilling operation, ultimately leading to successful project outcomes.

Experiment No.7:- Drill Rod Jointing

Aim of the Experiment: - To joint drill rod in drill string for further drilling.

Equipment Needed

- Drill rods
- Jointing tools (e.g., wrenches, sockets)
- Thread lubricant
- Safety gear (gloves, goggles, hard hat)

Procedure: -

Safety Considerations

- Always wear appropriate personal protective equipment.
- Ensure that the work area is clear of hazards.
- Use tools that are suited for the task and in good condition.

1. Preparation

- Ensure all equipment is clean and in good working condition.
- Gather all necessary tools and safety gear.

2. Inspect the Rods

- Check the threads of the drill rods for any damage or wear.
- Ensure that the rods are free from debris and contaminants.

3. Apply Thread Lubricant

- Apply an appropriate thread lubricant to the threads of the drill rod.
- This will help prevent galling and make the jointing process smoother.

4. Align the Rods

- Carefully align the two drill rods that need to be joined.
- Ensure that the threads are properly aligned to avoid cross-threading.

5. Jointing the Rods

- Hand-tighten the first rod onto the second rod until snug.
- Use a wrench to securely tighten the joint, ensuring not to over-tighten.

6. Check for Proper Jointing

- Inspect the joint to ensure that it is tightly secured and aligned.
- Look for any signs of misalignment or damage.

7. Repeat as Necessary

- If additional rods are needed, repeat the steps for each joint until the desired length is achieved.

Final Checks

- After jointing, perform a final inspection of the entire assembly.
- Ensure that all joints are secure and that there are no visible issues.
- Conduct a test run to verify that the drill setup operates as intended.

Conclusion: -

At the end of the experiment, I able to joint drill rod appropriately.

Thank you