BASIC AUTOMOBILE ENGINEERING Practical



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VERNIER CALIPER

EXERCISE

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EXERCISE 1

Aim

To find the outside diameter, inside diameter and depth of a given object accurately by using vernier caliper.

Equipments Required

Vernier caliper

Parts

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- Beam
- Fixed jaw for External Measurement
- Fixed jaw for Internal Measurement
- Movable jaw for External Measurement
- Movable jaw for Internal Measurement
- Main Scale
- Blade for depth measurement
- Adjusting finger grip
- Locking screw





Beam

Beam is the basic part of the verniercaliper. Main scale is graduated on beam. Each graduation in main scale equals to 1mm. Every tenth graduation line is marked as bold and big.

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Fixed jaw for External or Internal measurement

Fixed jaw is located left side top and bottom of the beam. These two jaws are attached with beam. Vernier unit is moving on the backside of the beam.

Movable jaw for External or Internal measurement

Both movable jaws are moving together during measurement. Main scale is graduated in between the movable and fixed jaw.

Vernier scale moves along with movable jaw in right side. By this movement we can able to measure as required. Vernier unit is locked by locking screw after measuring. To give more accurate measurement a fine adjusting screw is also provided.

Least Count

The least measurement that can be measured with an instrument is called least count. The least count is the difference between main scale division and vernier scale division.

Least count = Main scale division – Vernier scale division

Note

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Let	Main scale division	= 1mm
	Vernier scale division	= 9 / 10 = 0.9mm
	Then Least count	= 1-0.9
		= 0.1 mm

Material

Verniercaliper is manufactured with nickel chromium steel.

Depth bar

It is located on the backside bottom of the main scale. It is used to measure the depth of an object.

Procedure for Measurement

- Take the measurement in the main scale
- In vernier scale, note down the line which coincides with main scale.
- Now multiply least count with vernier scale measurement. This gives the vernier scale reading.
- Add main scale reading and vernier scale reading. This is the required measurement.



A model reading MSR = 2.3 cm ; VSC = 4 divisions; Reading = [2.3 cm+(4x0.01cm)] = 2.34 cm

Zero error

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When both jaws closed together, Zero error occurs when zero on the main scale coincides with the zero on the veriner scale.

Positive error

When both jaws closed together, the vernier scale zero is more than the zero on the main scale.

Negative error

When both jaws closed together, the vernier scale zero is less than the zero on the main scale.

If the error occurs, add or subtract from the measurement appropriately.

a) Outside Diameter

- Fix the given object in between the fixed jaw and movable jaw for external measurements.
- Using the adjusting screw, adjust and lock the locking screw.
- Now take the external measurement of the object.



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S.No	Description	Measurement
1	Main Scale Reading (MSR)	mm
2	Vernier scale Reading (VSR)	mm
3	Error (Positive/Negative)	mm
	Final measurement	mm

b) Inside Diameter

- Fix the given object in between the fixed jaw and movable jaw for internal measurement.
- Using fine adjusting screw, adjust and lock the locking screw.
- Now take the internal measurement of the object.

S.No	Description	Measurement
1	Main Scale Reading (MSR)	mm
2	Vernier scale Reading (VSR)	mm
3	Error (Positive/Negative)	mm
	Final measurement	mm

c) Depth

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- Take the depth measurement using bar given backside of the main scale in the verniercaliper.
- Adjust the length of bar by moving the movable jaw of a verniercaliper. Adjust and lock the locking screw.
- Now take the depth measurement of the object.

S.No	Description	Measurement
1	Main Scale Reading (MSR)	mm
2	Vernier scale Reading (VSR)	mm
3	Error (Positive/Negative)	mm
	Final measurement	mm

Conclusion

Measurements are taken accurately and tabulated.

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EXERCISE 2

Aim

To find the external diameter of the object accurately by using outside micrometer.

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Required Instrument

Micrometer

Parts

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- 'U' frame
- Anvil
- Spindle
- Lock nut
- Barrel (or) sleeve
- Major scale
- Minor scale
- Thimble
- Ratchet (or) Ratchet screw
- Knurled grip

Various Sizes of Micrometer

Outside micrometers are available in the following sizes.

- 1. 0 to 25 mm
- **2.** 25 to50 mm
- **3.** 50 to 75 mm
- **4.** 75 to 100 mm & above



Fig 1. MICROMETER

Description

Bolt and Nut principle is used in micrometer. Both the major scale reading and minor scale reading are on the barrel. One division in major scale equals to 1mm and 0.5 mm in minor scale. Major scale is marked above the datum line and minor scale is marked below the datum line. Thimble is divided into 50 equal parts and graduated on circumference. One division of thimble is 0.01 mm.

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One division on major scale	= 1 mm
One division on minor scale	= 0.5 mm
One division on Thimble	$=\frac{0.5}{50} = 0.01 \text{ mm}$

Anvil and Spindle ends are fitted with Carbidge tips.

If anvil and spindle are closed together, then thimble and the indexed line should coincide with '0'. When there is no error, this is called as zero error. Before taking the measurements, ensure that there is any error in the micrometer. Positive and Negative errors are adjusted by adding and subtracting with the measurements taken.





★A model reading PSR = 6 mm; HSC=40 divsions; Reading = [6mm+(40x0.01mm)]=6.40mm

Large Micrometer

• We can measure up to 25mm using 0-25 mm micrometer. Suitable size of extended anvil can be attached for measuring larger size.

Measuring Methods

- 1. Select correct size micrometer
- 2. Place the measuring object in between anvil and spindle.
- 3. Tight the thimble using ratchet stop.
- 4. Note down the main scale division reading.
- 5. Note down the sub scale division reading.
- 6. Note down the thimble reading. It is multiplied by least count.
- 7. Finally add all the measurement.

S.No	Explanation	Reading
1.	Major scale division	mm
2.	Minor scale division	mm
3.	Thimble reading	mm
4.	Error	mm
	Measurement	mm

Conclusion

Outside diameter is measured accurately using micrometer and the measurements are tabulated.



DECARBONISING

EXERCISE

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EXERCISE 3

Aim

To remove the carbon settled on cylinder block, cylinder head and piston head in the engine block.

Equipment Required

An engine.

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Tools Required

- 1. Double End Spanner set,
- 2. Wooden Mallet,
- 3. Screw driver,
- 4. Scrapper,
- 5. Drilling machine,
- 6. Wire brush.

Materials Required

- 1. Cotton waste,
- 2. Kerosene,
- 3. Emery sheet,
- 4. Fine cloth,
- 5. Compressed air.





Reasons for Decarbonising

- 1. Black smoke exits through silencer.
- 2. Pre Ignition

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- 3. More exhaust noise
- 4. Back firing
- 5. Due to depreciated piston ring the lubrication oil get burned and settled on the combustion chamber

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Fig 2. Cylinder block - Before Decorbonising

Procedure for Dismantling

- 1. The following parts to be removed in order:
 - Fan belt
 - Dynamo
 - 🗅 Fan

- □ Water pump
- Exhaust manifold
- □ Air cleaner
- Carburettor
- Inlet manifold
- 2. Lubrication oil needs to be drained completely, the oil pump and oil gallery tube to be removed.
- 3. Ignition coil, distributor, petrol pump and oil pump to be removed.
- **4.** After removing the valve door, Tappet Push rod, Rocker arm, Valve spring, Spark plug or diesel injector will also be removed.
- 5. After all the parts are separated, cylinder head to be removed by wooden mallet and to be kept in a clean place.
- 6. The Crank Shaft need to be moved to TDC and the carbon particles on the piston head and to be removed by scrapper using clean cloth.





Fig 3. Cylinder block - After Decorbonising

Precaution

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When Cleaning one Cylinder piston close all other Cylinder by Cloth, otherwise the carbon particles damage the other cylinder and Piston by the Carbon Particles.

Re – Assembling

After decarbonising process is finished, all the parts are assembled in the reverse manner of the dismantling inorder

Note

During Assembly process use new Gasket for all Joints.

Conclusion

After Completing the decorbornising process all the parts are re – assembled

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CARBURETTOR

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EXERCISE 3

Aim

To remove the carburettor from a given engine repair service and refix.

Equipment Required

Engine

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Tools Required

- 1. Double ended spanner
- 2. Screw driver
- 3. GO- NOGO Gauge
- 4. Magnifying glass-10x

Materials Requred

- 1. Soft cloth
- 2. Sufficient petrol
- 3. Low pressure air
- 4. Sprit senor paper
- 5. Fine brush





Fig 1. Carburettor - Line Diagram



Fig 2. Carburettor



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Fig 3. Carburettor

Reasons For Dismantling

- 1. Air fuel mixture does not come to the engine from the carburettor.
- 2. Efficiency of the engine is less.
- 3. KMPL of the engine decreases.
- 4. Starting trouble due to repair in the Accelerator Pump Circuit.
- 5. Starting trouble of the engine
- 6. Sudden halt of the engine while running
- 7. Time lapse as recommended periodical inspection by the company.

Removal

- 1. After completing all precautionary steps the carburetor to be removed from the engine.
- 2. First drain plug need to be removed from the carburetor and the fuel need to becollected in a vessel and to be kept in a safe place
- 3. Inlet connection need to be removed. Inlet joints to be kept closed using a clip if it is flexible.
- **4.** Air cleaner connection need to be disconnected.
- 5. Carburettor need to be removed from the Engine Inlet Manifold and to be kept in a highly ventilated room.

Dismantling

- 1. Remove the Carburettor top lid with a proper tool.
- 2. Remove the hinge plate pin in the float chamber and place in a tray.
- **3.** Float need to be taken out and cleaned and to be kept in a jar with weight over it and immersed with spirit to see if there is any damage in the float.

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- **4.** Float need to be kept in the same position for some time. Place the sprit sensor paper on the circumference of the float for checking the crack.
- 5. Check and replace the float with new one if there is any damage.
- 6. Starting circuit need to be removed with proper tools and lever, starting valve, washer to be kept in a tray after removing separately.
- 7. Distributor passage to be removed with proper tools and its gasket to be removed and to be kept in a tray separately.
- 8. Take the Main jet out.
- 9. Remove the valve in the outlet separately.
- 10. Idling speed adjusting Screw spring to be kept in a tray without damage to its tip.
- 11. Remove the Pilot jet adjusting screw using proper tools and keep in the tray. Check for any damages without opening the throttle valve.

Servicing

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- 1. Clean all the dismantled parts with petrol.
- 2. Wipe all the parts with fine cloth.
- 3. Clean the Small passages with fine brush.
- 4. Clean all the parts using low pressure air.

Inspection

- 1. Check the Carburettor for damages with magnifying glass
- 2. Replace with the new one if there is any crack or damage found
- 3. Check the Throttle valve for any damage.
- 4. Check the Main Jet with Go No Go gauge.
- 5. Check the Idling adjusting Screw with needle. Reject and replace with a new spare if not in good condition.

Re-Assembling

- 1. Assemble in the reverse process of dismantling in order.
- 2. While assembling gasket, replace the washer with new spares.

Conclusion

The given carburetor is examined, serviced and fixed in the engine.

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EXERCISE 5

Aim

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To remove the oil pump from the given engine and reassemble the same after checking and servicing.

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Equipments Required

An Engine (any type)

Tools Required

- 1. Double End spanner set
- 2. Feeler gauge
- 3. Screw driver
- 4. Ring spanner set



Fig 1. Gear type Oil Pump

Materials Required

- 1. Waste Cotton
- 2. Kerosence
- 3. Degreaser
- 4. Lubricating Oil SAE 30
- 5. Emery sheet

Reasons for Dismantling

- **1.** Low oil pressure
- 2. Block in oil filter
- 3. Loose connection in suction of oil filter
- 4. Hole in Oil filter
- 5. Company recommended period of inspection and servicing lapses

Dismantling

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- 1. Start and run the engine up to the working temperature reaches 70° C.
- 2. Stop the engine and drain the oil from the sump after some time.
- 3. Remove the connections of inlet and outlet of the oil pump.
- 4. After removing the distributor remove the oil pump from the crankcase.
- 5. Dismantle Driving gear, Driven gear and all other parts and clean them by degreaser and kerosene.

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Inspection

a) Gear Type Oil Pump

- 1. To check the damages of the gears and clean the surface by using emery sheet.
- 2. Check the gap between pump shafts and pump body. (Pump shaft to body clearance).
- 3. Check the gap between drive Gear and Pump Shaft. (Drive gear to spindle clearance).
- 4. Check the gap between Gear and Pump body (gear to body clearance).
- 5. Measure the gap between pump shaft guide to guide push clearances.



Fig 2. ROTOR type Oil Pump

b) Rotor Type Oil Pump

- 1. Check the gap between outer rotor body clearances.
- 2. Check the gap between pump shaft and rotor clearance.

Reassembling

- Reassemble the oil pump in the crankcase at the same time slowly rotate the camshaft and tight the fixing bolt.
- If pressure relief value is located in the oil pump then clean and refit the cover, spring and adjusting screw.
- After filling the oil sump with sufficient oil and start the engine. Check the oil pressure by increasing the speed of engine slowly and compare the pressure with the recommendation of the manufacturer.
- While fixing the oil pump in the crank case the camshaft is slowly rotated and fixing bolt is screwed.



• If pressure relief valve is joined with the pump cover, then spring, adjusting screws need to be removed and cleaned and refitted in the correct manner.

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• Start the engine after the oil sump is filled with lubricating oil. The pressure of the lubricating oil is measured by pressure gauge by increasing the engine speed and compared with recommended quantity by the company.

Precaution

- Compare the actual clearances with the recommended clearances by the manufacturer. If it exceeds the limit, pumps will not be allowed to use.
- If the gear or rotor has any breakage or crack, the pump will be rejected and new one should be replaced.

Conclusion

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Fuel pump from the given engine is dismantled, examined and reassembled after servicing.





EXERCISE 6

Aim

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To dismantle the AC Mechanical fuel pump, examine and assemble it after servicing

Equipment Required

Petrol Engine.

Tools Required

- 1 Screw driver
- 2. Double end spanner set
- 3. Copper wire
- 4. Scrapper



Fig 1. Mechanical Petrol Pump



Materials Required

- 1. Fine brush
- 2. Petrol
- 3. Cloth
- 4. Compressed air



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Fig 2. Mechanical Petrol Pump - Line Diagram

Reasons for Dismantling

- 1. No fuel supply during starting
- 2. Petrol leakage in the lower chamber
- 3. Petrol leakage in the passage hole
- 4. Starting trouble in the engine
- 5. Company recommended period of inspection and servicing lapses

Dismantling

- 1. All the precautions must be followed before dismantling the pump filter, valveretainer, rubber gasket, filter element which are located on the top of the pump will bekept in a tray.
- 2. Mark the top chamber and bottom chamber to avoid wrong fitment before dismantling the screws.



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3. While removing, the diaphragm may stick to the upper chamber. So required caution to be taken.

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4. Remove the Grub screw joining the Rocker arm and keep separately.

Inspection and Servicing

- 1. Check if the filter element is damaged
- 2. Check if the diaphragm is damaged and if so replace it with new one.
- 3. Check if the inlet valve and outlet valve in the valve retainer are working well.
- 4. All the removed particles are cleaned with petrol using brush.
- 5. Check if the spring and Valve seats are damaged and if so they are replaced by new ones.

Reassembling

- 1. Fix the valve retainer in the right place and screw with bolt and nut.
- 2. By pressing the Diaphragm assemble rocker arm in the lower chamber
- 3. Tightly screw Rocker arm with bolt to avoid disconnection
- **4.** Bring the holes on the Lower chamber, diaphragm and upper chamber in a straight manner. Then, join them with screws.

Conclusion

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The serviced petrol pump is tested for correct measurement and pressure of pumping petrol and fixed in the engine.

SILENCER

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EXERCISE 7

Aim

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To dismantle, examine and refix the silencer after servicing.

Equipments Required

Any Vehicle

Tools Required

- 1. Double end spanner set
- 2. Screw driver
- 3. Hammer
- 4. Wooden Mallet
- 5. Hack saw frame with blade

Materials required

- 1. Cotton waste
- 2. Kerosene long rod
- 3. Wire brush.

Reasons for Dismantling

- 1. Pulling power of the engine is reduced.
- 2. Starting trouble in the engine.
- 3. Exit of black smoke from the silencer
- 4. Back firing & Oil leakage
- 5. Noisy Engine

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EXHAUST GAS INLET EXHAUST PIPE EXHAUST PIPE SILENCER

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EXHAUST SYSTEM

Fig 1. Silencer





Dismantling

- 1. Remove the Mounting bolts and clamps of the silencer.
- 2. Remove the Bolts from Exhaust manifold and keep separately.
- 3. Remove the Exhaust pipe and silencer and keep separately.
- **4.** Using wooden mallet, hammer the sides and up and down of the silencer to remove the carbon particles which disturbs the flow.
- 5. Heat the Silencer well and allow it to cool for some time. Then, hammer it by mallet, move the iron rod inside the silencer to remove carbon particles.
- 6. Use Rod or wire brush to remove carbon particles

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Fig 3. Silencer - Corediagram

Note

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If the silencer is attached with the catalytic convertor, then service the same after knowing the type of convertor and its properties.

If the settling of carbon particles are high, then cut the silencer by Hack saw blade and welded again after servicing.



Fig 4. Catalytic Convertor type Exhaust System

Re-assembling

- 1. Silencer is assembled in the reverse process of dismantling the parts.
- 2. Silencer is fixed with new or serviced washer.

Conclusion

Silencer from the given Vehicle is serviced in the correct method and fixed.

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PISTON ASSEMBLY

EXERCISE

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EXERCISE 8

Aim

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To dismantle, Inspect, Service and Reassemble the Piston assembly of the engine.

Equipment Required

Any Engine

Tools Required

- 1. Double end Spanner
- 2. Ring Spanner Set
- 3. Outside Caliper
- 4. Feeler Gauge
- 5. Iron Hammer
- 6. Steel drift
- 7. Vernier Caliper
- 8. Ring Compressor and
- 9. Ring Expander

Materials Required

- 1. Cotton Waste
- 2. Emery Sheet



Fig 1. Piston and Connecting Rod Assembly - Line Diagram

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Reasons for Dismantling

- 1. RPM of the engine is decreased
- 2. BHP of the engine is decreased
- 3. Over Fuel Consumption
- 4. Reduced Compression Level in the3 cylinder
- 5. Outlet of Black Smoke through the Silencer
- 6. Consumption of Excess Lubrication Oil
- 7. Noisy Operation of the Engine
- 8. Company recommended period of inspection and servicing lapses



Fig 2. Piston and Connecting Rod Assembly

Dismantling

- 1. With all precautions dismantle the cylinder, Head, Crank case and keep the engine stand.
- 2. Mark the number on the connecting rod big end by using number punch
- 3. With the help of spanner ,remove the nuts of connecting big end bearing with the connecting rod and take the piston assembly through cylinder head.
- 4. Check if the bearing is depreciated and if so reconditionor replace the new bearing
- 5. Remove other piston assembly and keep it on a tray.

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- 6. Change the Piston Circlip if it is loose
- 7. Change Piston ring if it is depreciated
- 8. Use wooden mallet to fix piston assembly into the cylinder block



Fig 3. Piston and Connecting Rod Assembly

Assembling

Assemble in the reverse process of dismantling. Apply lubrication oil on the cylinder walls before fixing piston assembly to cylinder block.

Conclusion

Assemble the piston assembly in the Engine after servicing.

Note

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Can do the piston assembly in the class room and practical exam with the aviability of different piston spares.



EXERCISE 9

Aim

To Dismantle, Inspect, Service and reassemble the water pump from an engine

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Equipments Required

An engine

Tools Required

- 1. Double End spanner set
- 2. Puller

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- 3. Drift punch
- 4. Hammer



Fig 1. Water Pump

Materials Required

- 1. Kerosene
- 2. Cloth

Reasons for Dismantling

- 1. Noise in the bearing
- 2. Over heat in the engine
- 3. Leakage of water in between Engine and water pump
- 4. Too loose or too tight fan belt affects water rotation
- 5. Time lapse as recommended by the company



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Fig 2. Water Pump - Line Diagram

Dismantling

- 1. Remove the rubber hose from radiator lower tank before removing the water pump
- 2. Remove the fan belt.
- 3. Remove the water in the upper part of water jacket after removing the fan.
- **4.** Remove the dynamo.
- 5. Remove the water cooling pump assembly from the engine.
- 6. Remove the Fan belt pulley using correct tools from the water pump
- 7. Remove the thermostat valve.

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Cleaning and Inspection

- 1. Clean the water pump parts by using degreaser after taking out of the engine
- 2. Remove the pump shaft slowly by using drift pin, copper hammer and wooden mallet.

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- 3. Check the impeller is broken
- 4. Check if the pump shaft shake and replace it if the shake is more.
- 5. Change the bearing if it is too loose.

Precaution

Before fixing the water pump replace new water seal, oil seal and gasket.

Re-assembling

Assembling is the reverse process of dismantling in the correct order.

Conclusion

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After dismantling, Inspecting and servicing the water pump is fixed in the given engine.



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EXERCISE 10

Aim

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To Dismantle, Inspect and reassemble the diesel injector from a given diesel engine.



Fig 1. Diesel Injector

Equipments Required

Diesel Engine

Tools Required

- 1. Double end spanner set
- 2. Ring spanner set
- 3. Screw driver
- 4. Hammer



Fig 2. Diesel Injector - Line Diagram

Reasons for Dismantling

1. Low engine speed.

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- 2. Low pulling power of engine .
- 3. Diesel was not injected from injector
- 4. Uneven speed of the engine
- 5. Company recommended period of inspection and servicing lapses

Removal

- 1. Remove the diesel tube from injection pump
- 2. Remove leak off pipe from the injector
- 3. Remove injector from cylinder head using proper spanner.
- 4. Put the injector on the tray and keep it in a clean and air ventilated room.

Dismantling and Cleaning

1. Remove the diesel injector spindle, spring, washer, adjusting screw from injector and put on the tray.

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- 2. Clean all the parts of injector using kerosene.
- 3. Again clean all the parts of injector using cloth.
- 4. Check any crack in the injector body and the nozzle.
- 5. If any crack is found change new injector.
- 6. Check any block in the inlet passage and leak off passage.
- 7. Check the bottom of the injector hole and also clean the carbon deposit.



Fig 3. Diesel Injector

Reassembling

Assemble is the reverse process of dismantling in the correct order.

Note

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- After cleaning the diesel injector, again sent to the final inspection.
- The diesel injector is used after pressure test, spray test and leak off test are done.

Conclusion

After dismantling, inspecting and servicing fix the diesel injector in the engine.