A REPORT ON INDUSTRIAL WORK EXPERIENCE SCHEME II

BY

OYEFUSI, OLUWATOBI DAVID.
MATRIC NO: EU160307-1021

A REPORT SUBMITTED TO THE SIWES UNIT IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING DEGREE IN MECHANICAL ENGINEERING

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING
FACULTY OF ENGINEERING,
ELIZADE UNIVERSITY, ILARA-MOKIN,
ONDO STATE, NIGERIA.

NOVEMBER, 2018.

CERTIFICATION

This is to certify that this work was carried out by me: **OYEFUSI, OLUWATOBI DAVID** of Matric number **EU160307-1021** at Toyota Nigeria Limited for the duration of 6 months has been duly completed has required by the Industrial Training Fund (ITF) and Department of Mechanical Engineering, Elizade University, Ilara-Mokin. Ondo State, Nigeria. Also this is to certify that this report has been written in accordance to the guidelines and format laid down by Elizade University.

…… ……

Student Signature Date

LETTER OF SUBMISSION

Department of Mechanical Engineering,
Faculty of Engineering,
Elizade University,
Ilara mokin, Ondo State.
8th November, 2018.

SIWES Coordinator,
Elizade University,
Ilara mokin, Ondo State.
Dear Sir,

SUBMISSION OF INDUSTRIAL TRAINING REPORT

I use this medium to notify you that I have successfully completed the 8 weeks Students Industrial Work Experience Scheme for the 2017/2018 session, which commenced on the 2nd of April, 2018 and ended on the 30 of September, 2018 at Toyota Nigeria Limited located at TPAO 992, Ojulari road, Lekki Peninsula, Lekki, Lagos state.

I hereby tender this submission letter alongside my industrial training report and log book in partial fulfillment of the requirements for the award of Bachelor of Engineering (B. Eng.) Degree in Mechanical Engineering, Elizade University.

I greatly appreciate your effort and the effort of the Industrial Training Coordinating Centre as a whole for making the SIWES program a success.

Yours faithfully,

OYEFUSI Oluwatobi David.

EU160307-1021

ACKNOWLEDGEMENT

My sincere appreciation and gratitude goes to the management and staffs of the Department of Mechanical Engineering, Elizade University. To the Dean of Engineering in person of Prof. Femi KOYA who have been a great leader, I say a big thank you.

To the entire staff and management of Toyota Nigeria Limited, I would love to express my heartfelt gratitude.

My appreciation goes to the following individuals Engr. Irabo, Engr. Saheed, Mr. Afolabi and Mr. Odus from Toyota Nigeria Limited. Mr. Elias IBRAHIM and Mr. Owobamiduro, Oluwatobi for their great encouragement and support for this six months IT.

DEDICATION

This report is dedicated foremost to God Almighty for his favor, mercy and grace upon my life especially during my 6 months SIWES programme at Toyota Nigeria Limited.

I would also like to dedicate it to my parents and siblings for their love and support and everyone else that contributed towards making my SIWES training a fun and successful one.

SUMMARY

This Industrial Report presents the experience garnered during my three months of Industrial Training undertaken at Toyota Nigeria Limited, TPAO 992, Ojulari road, Lekki Peninsula, Lekki, Lagos.

My training was on diagnosis, repairs, maintenance in automobile vehicle ranging from cars, SUVs, coupe, convertible, light trucks, crossover and pickups and work done at Warehouse section.

During this period, I acquired practical knowledge on how to repair, replace and install some mechanical parts and systems also assisted in providing the units the functionality they need.

This report discusses the technical skills gained during the training period and justifying the relevance of the scheme in equipping students with needed technical competence to thrive in the real world.

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CHAPTER 1

INTRODUCTION TO TRAINING PROGRAM

1.0 GENERAL BACKGROUND & NAME OF COMPANY

The Toyota brand was first introduced into Nigeria in 1965. By 1976, the number of Toyota distributors had grown to five.

Ten years later, Toyota Motor Corporation, Japan (TMC) appointed two additional distributors because of poor performance by some of the appointed distributors. At this time, the country was passing through a phase of economic transformation that led to the ruling government adopting an economic Structural Adjustment Program (SAP) to stabilize the system. This led to major changes in the Nigerian business environment of which the automobile industry was not insulated from.

By 1995, four distributors; which included Elizade Nigeria Limited were the only surviving distributors for Toyota Motor Corporation, Japan. However, for ease of business processes and efficiency, Toyota Motor Corporation, Japan, decided to consolidate its operations by appointing Toyota (Nigeria) limited as its sole distributor in Nigeria.

This consequently paved the way in 1996 for Toyota (Nigeria) Limited (TNL) to commence operations as the exclusive distributor of Toyota Motor Corporation in Nigeria. In its early days in Nigeria, the Toyota brand had to strive for acceptance, particularly in the face of stiff competition from the established brands at the time.

For over two decades now, the company has remained the exclusive franchise owner of the Toyota brand in Nigeria and has consistently sustained the top spot for the brand in the Nigerian automobile industry. This remarkable success story is attributable to the ingenuity and resourcefulness of the board of directors under the indefatigable Chairmanship of Chief Michael Ade. Ojo OON. His vision, industry and tireless commitment to the brand over the years paved the way for the acceptance of the Toyota brand in Nigeria.

Complementing the hard work of the board is a dynamic management team under the leadership of the Managing Director, Mr. Kunle Ade-Ojo. This youthful administrator who possesses B.Sc. Mechanical Engineering from University of Reading and M.Sc. Automotive Engineering from Cranfield University both in United Kingdom has injected youthful verve and rare sense of professionalism into the entire team of Toyota (Nigeria) Limited. This has impacted positively on the fortune of the multiple awards winning auto brand as it has continued to break new grounds in the market place to the satisfaction of its customers.

1.1 COMPANY'S VISION STATEMENT

To consistently be the leading automobile brand in Nigeria

1.2 COMPANY'S MISSION STATEMENT

Toyota Nigerian Limited mission statement is to provide the ultimate auto brand experience through a strong dealer network driven by excellent relationship with our stakeholders.

CORE VALUES

Business integrity and ethic; Being opened, truthful and honest in all we do.

Team spirit; we value strength in unity**.**

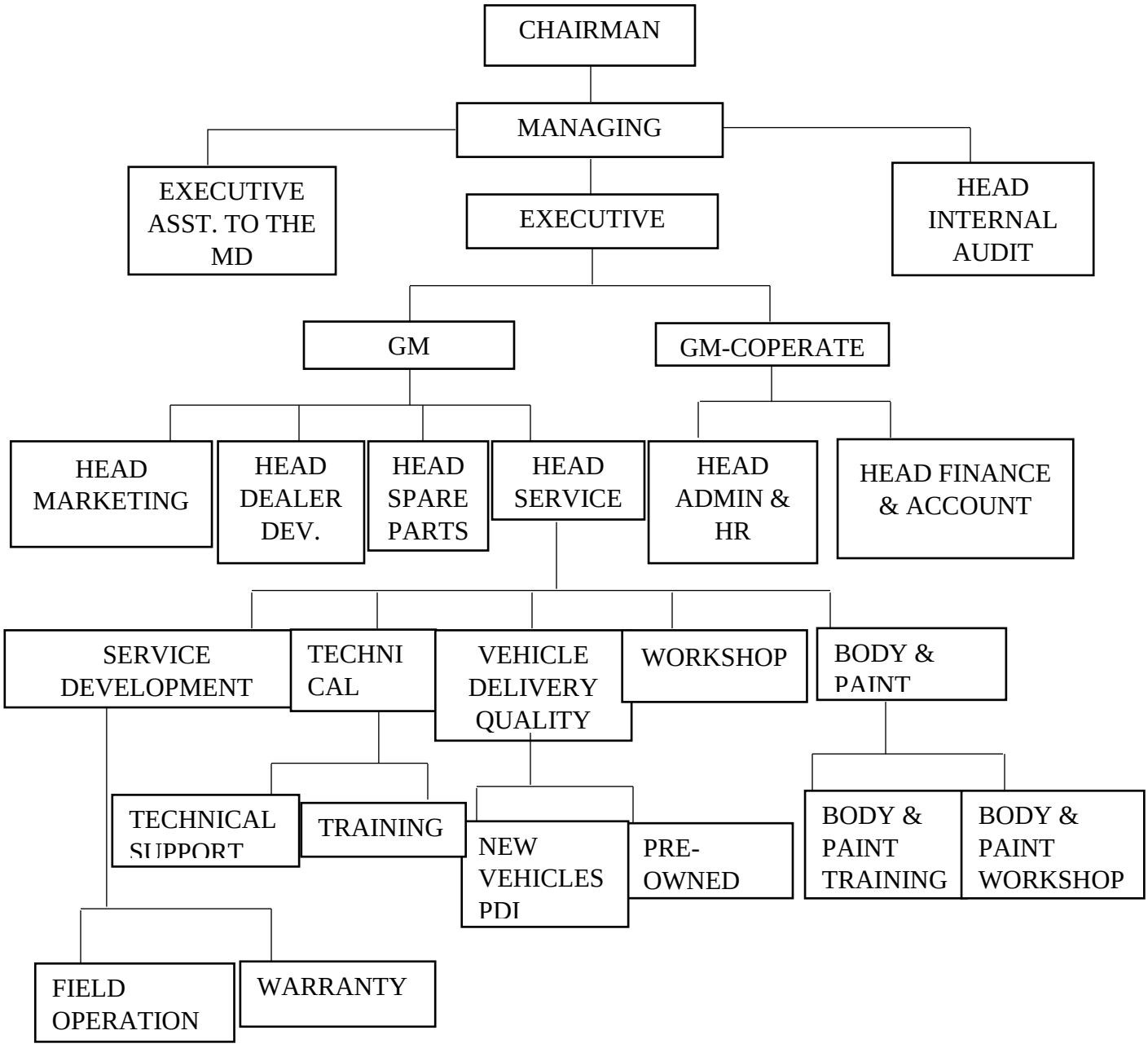
Sense of urgency; we act now, not later.

Customer Satisfaction; we exist for our customers

Personal efficiency; we do it right, now and always

Creativity; we seek improved ways of doing things

1.3 ORGANIZATION STRUCTURE



1.4 DEPARTMENTS

Toyota Nigeria Limited is made of the following Departments,

1. Marketing Department
2. Dealer Development Department
3. Spare parts Department
4. Service Department
5. Administrative Department
6. Finance and Accounting Department

Administration department; this has Human and Resource Department as a sub-department. The main responsibility of the administration unit is to process company related document and files

FUNCTIONS;

1. To process paper works for external suppliers.
2. To process paper work for company staff.
3. The department is responsible with the passing of information to the staff.
4. Sending out any mail on behalf of the company. This could be for different stakeholders and even for company staffs.
5. The admin department is responsible for proper entering and safe keeping of document for easy reference in the future.

Service department; the department has a Workshop in it and the sole responsibility of the department is to handle all repairs, maintenance pertaining to automobiles and training of Trainees from Dealers

FUNCTIONS;

1. The department provides a friendly working environment for the technicians.
2. The department is responsible for all maintenance and proper use of machines, tools and equipment
3. The department is also responsible for the safe keeping of customer cars t
4. It takes care of the safety and welfare of the workshop technicians.
5. The department open grounds for Toyota dealers technicians to be trained on latest Toyota Automobiles

Finance and Accounting department; this department I love because it is responsible for the payment of my monthly allowance.

FUNCTIONS;

1. In Toyota Nigeria Limited, this department is responsible for payments of salaries and wages to workers.
2. It also prepares a balance sheet at the end of every month or end of the year to able proper assessment of the company financial situation.
3. The department receives payment for sale and other services render to customer on behalf of the company and it has the responsibility of proper recording of fund received.
4. The department makes payment for a wide variety of purchases, property taxes and loans.

5. It is responsible for the financial control, and also preparation of financial statements of the company

Spare parts department; the department is solely responsible for the safe keeping of spare part and vehicles.

FUNCTIONS;

1. The department is responsible for issuing out spare parts to technicians.
2. Also responsible for the sale of spare parts.

1.5 PURPOSE OF TRAINING

The Students Industrial Work Experience Scheme (SIWES) was initiated in 1973 by the Industrial Training Fund (ITF). This was to update practical knowledge of students in the Universities, Polytechnics and Colleges of Technology. It was aimed at bridging the gap between the theoretical knowledge acquired in classes and technical knowledge in the industries by providing students with the opportunities to apply their educational knowledge in real work situations.

3. Over the years, SIWES has contributed immensely to building the common pool of technical and allied skills available to the Nigerian economy which are needed for the nation's industrial development.
4. Furthermore, the place and relevance of SIWES is underscored by the fact that the scheme contributes to improving the quality of technical skills generally available in the pool from which employers' source technical manpower.
5. It also gives students the opportunity to blend theoretical knowledge acquired in the Classroom with practical hands-on application of knowledge required to perform work in the industry. Also, it prepares students for employment & makes the transition from school to the world of work easier after graduation.
6. I undertook my SIWES training at TOYOTA NIGERIA LIMITED which is located at TPAO 992, Ojulari Road, Lekki Peninsula Scheme, Lekki, Lagos State which Lasted from April 2, to September 30, 2018

CHAPTER 2

THE TRAINING PROGRAM

2.0 DESCRIPTION OF WORK DONE

During my stay in Toyota Nigeria Limited, I was assigned to the service and maintenance department as a Diagnosis/Mechanical Technician. Job duties in the department includes; Keep equipment available for use, inspecting and testing vehicles; completing preventive maintenance such as engine tune-ups, oil changes, replacing filters, wheel balancing. Maintaining vehicle functional condition by listening to operator complaints; conducting inspections, repairing engine failures, repairing mechanical systems malfunctions; replacing parts and components. Verifies vehicle serviceability by conducting, test drives; adjusting controls and systems.

SAFETY

Accident in the workshop claim far too many victims and approximately 70% of these accidents are caused by neglect and carelessness on the part of the workmen hence, the need for safety cannot be overemphasized.

My first day at the company on the 2nd of April, 2018, I was made to understand all safety rules that govern the proper and safe operation of a standard automobile workshop. Included in my later of acceptance for industrial base training is a list of safety material I should resume with, the material were examined and I was given an orientation on general automobile workshop safety and safe practices with emphasis on fire hazard.

SAFETY EQUIPMENTS;

- Engineering overall
- Industrial steel toe safety boot
- Cotton and rubber hand glove
- Safety goggle
- Face masks and nose masks
- Fire extinguisher

2.1 AUTOMOTIVE MECHANICAL SYSTEMS AND SERVICES

2.10 ENGINE

Internal combustion engines run on a mixture of fuel and air, the core of the engine is the cylinder, with the piston reciprocating up and down inside the cylinder and this takes place in a four stroke process, which are Intake, Compression, Power and Exhaust. The piston moves down on the intake stroke, the intake valve is open and the fuel air mixture is admitted into the cylinder, and the piston moves up during the compression stroke both valves are closed, compresses the trapped fuel air mixture that was brought during the intake stroke, thereafter the spark plug fires, igniting the compressed air- fuel mixture which produces a powerful expansion of the vapor which is used to drive the crankshaft and this is the power stroke. Finally during the exhaust stroke, where the piston is at the bottom of the cylinder the exhaust valve opens to allow the burned gas to be expelled to the exhaust system.

Engine Types

The majority of engines in motor vehicles today are four stroke, spark ignition internal combustion engines, Diesel engine which are called Compression ignition Engine. There are several engine types which are identified by the number of cylinders and the way the cylinders are laid. Straight line cylinders have their cylinders in row while the “V” arrangement uses two banks of cylinders side-by-side and its commonly used in V-6, V-8 configurations

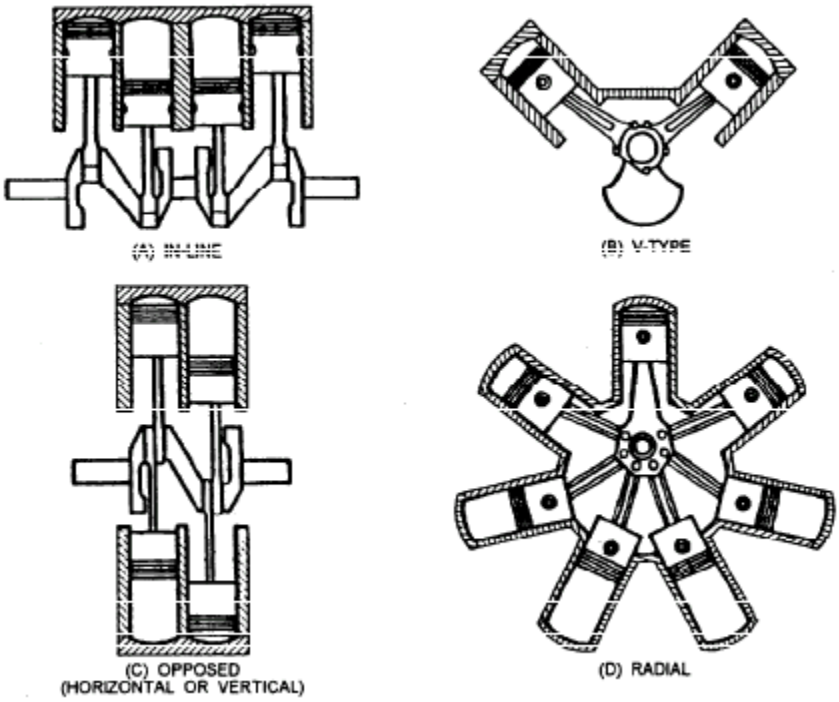


Figure 2-10.—Typical cylinder arrangements

Some Automobile engine parts include;

Spark Plug

The spark plug supplies the spark that ignites the air/fuel mixture so that combustion can occur. The spark must happen at just the right moment for things to work properly.

Valves

This consist of both the inlet and exhaust valves which open at their proper time to let in air and fuel and to let out **exhaust**. Both valves are closed during compression and combustion so that the combustion chamber is sealed.

Piston

Piston is a cylindrical piece of metal that reciprocates up and down inside the cylinder.

Piston rings

Piston rings provides a sliding seal between the outer edge of the piston and the inner edge of the cylinder. The rings serve two purposes:

- They prevent the fuel/air mixture and exhaust in the combustion chamber from leaking into sump during compression and combustion.
- They keep oil in the sump from leaking into the combustion area, where it would be burned and lost.

Most cars that "burn oil" and have a quart added every 1,000 miles are burning it because the engine is old and the rings no longer seal things properly.

Connecting rod

The connecting rod connects the piston to the crankshaft. It can rotate at both ends so that its angle can change as the piston moves and the crankshaft rotates.

Crankshaft

The crankshaft turns the piston's up and down motion into circular motion just like a crank on a jack-in-the-box does.

Camshaft

The camshaft in an internal combustion engine makes it possible for the engine’s valve to open and close, the asymmetrical lobes of the camshaft correspond to the engine valves.

Sump

The sump surrounds the crankshaft. It contains some amount of oil, which collects in the bottom of the sump (the oil pan)

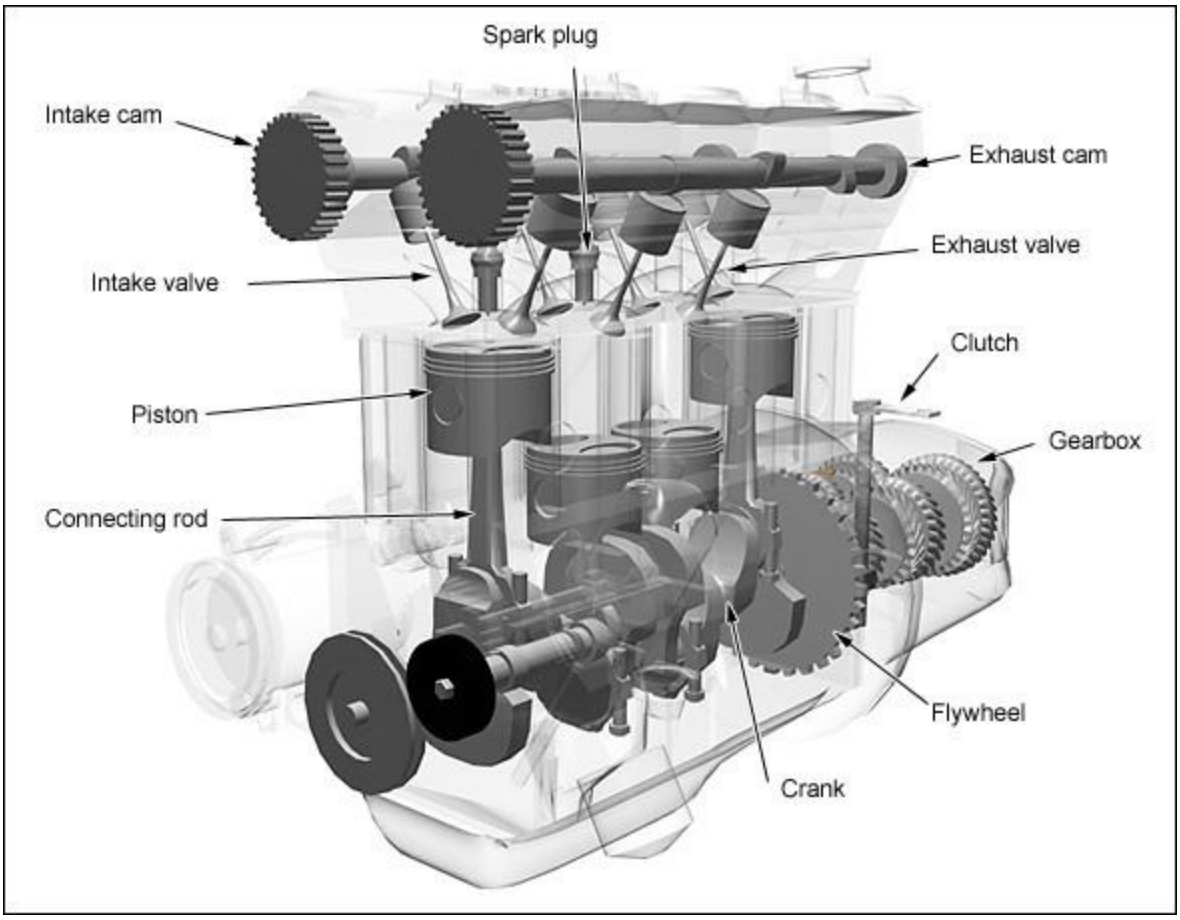


Fig. 2.1 **A typical inline four stroke engine**

2.11 LUBRICATING SYTREM

Oil is the life-blood of the engine. An engine running without oil will last about as long as human without blood. Oil is pumped to all the moving parts of the engine by and oil pump. The oil pump is mounted at the bottom of the engine in the oil pan (sump) and is connected by a gear to either the crankshaft or camshaft. This way, when the engine is running the pump is pumping simultaneously. There is usually an oil pressure sensor near the oil pump that monitors pressure and sends this information to a warning light on the dash board (this features is found in modern cars as it might be in your car), when the ignition key is turned on, but before the car is started the oil light should light, indicating that there is no oil pressure yet, but also letting you know

that the warning system is working.

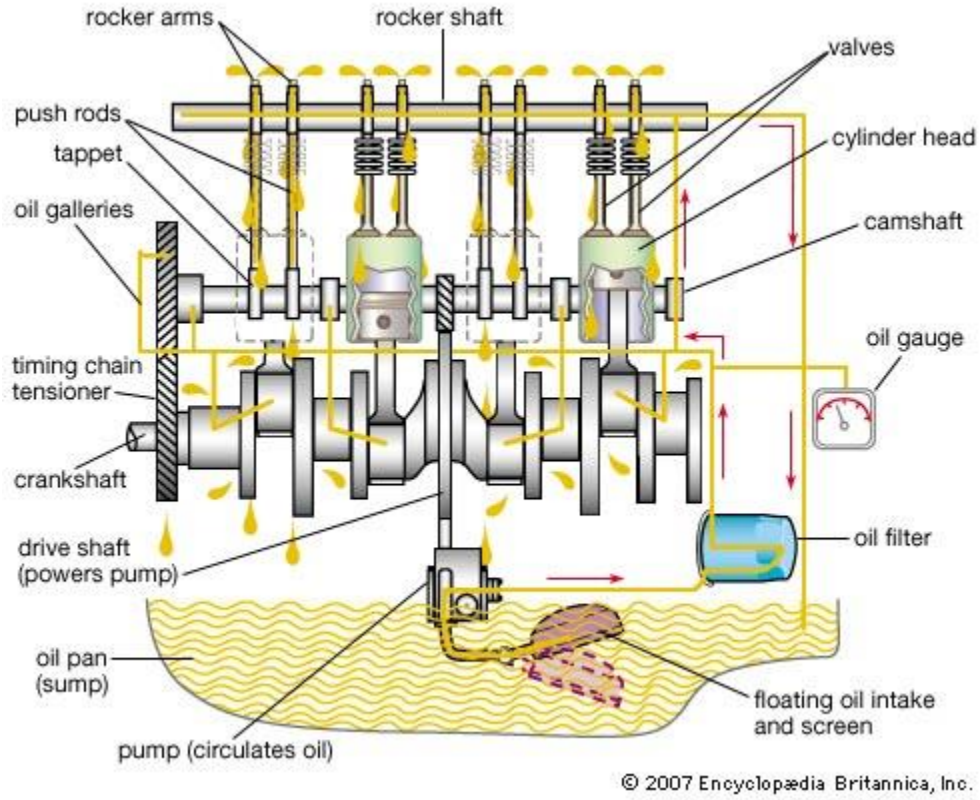


Fig. 2.11 **Lubricating system of a vehicle**

2.12 SIMPLE ENGINE SERVICE

Remove;

- I warm up the engine to allow for easy flow ability of engine oil.
- I pull out the dipstick and wiped it with a clean cloth.
- I lifted the vehicle to a suitable height with a two pillar electric powered hydraulic vehicle lift.
- I went under the car, loosed the oil sump protector which is mostly fastened with 8mm or 10mm bolts. I then loosen the drain plug bolt with the appropriate wrench size which

varies according to the vehicle manufacturing region. Mostly 14mm socket size for Asia vehicles, 13mm, 15mm, 17mm or 18mm for European vehicle.

- I drained the oil into an oil drain container.
- I also remove the oil filter using the appropriate oil filter wrench size

Install;

- I fixed a new oil filter into position
- With the help of the oil drain container rollers I pushed the oil drain container from under the vehicle.
- I tightened the drain plug bolt and installed the sump protector.
- I pushed the release button to return the vehicle to the ground level, after which I inserted the clean dipstick into the oil measuring pipe.
- I poured the appropriate quantity of engine oil.
- I started the engine and wait for the engine to warm up to it operating temperature.
- I lifted the vehicle to a suitable height and checked for leakage
- I release the vehicle to the ground level turned off the engine and check the oil level using the dipstick.
- I fixed the engine cover and close the hood.

Precautions;

- I avoided direct contact with used oil as this may cause skill cancer on the long run.
- I handle hot oil with care
- I made sure I do not work on the engine while engine is running.
- I guided against oil spillage on the workshop floor.

2.13 COOLING SYSTEM AND SERVICE

A car engine produces enormous amount of heat when it is running, and must be cooled continuously to avoid engine damage, generally this is done by circulating coolant liquid usually water mixed with an antifreeze solution through special passages.

How the cooling system works?

Actually there are two types of cooling system found on motor vehicles**: liquid cooled** and **air cooled**. Air cooled engines are found on a few older cars, but for most part, automobiles and trucks use liquid cooling systems and that is what this write up will concentrate on subsequently. The cooling system is made up of the passages inside the engine block and heads, water pump to circulate the coolant, a thermostat to control the temperature of the coolant, a radiator cap to control the pressure inside the system, and a plumbing consisting of interconnecting hoses to transfer the coolant from the engine to the radiator and also to the car's heater system where hot coolant is used to warm up the vehicle's interior on a cold day.

A cooling system works by sending a liquid coolant through passages in the engine block and heads. As the coolant flows through these passages, it picks up the heated fluid then makes its way through a rubber hose to the radiator in the front of the car. As it flows through the thin tubes in the radiator, the hot liquid is cooled by the air stream entering the engine compartment from the grill in front of the car. Once the fluid is cooled, it returns to the engine to absorb ore heat. The water pump has the job of keeping the fluid moving through this system of plumbing and hidden passages. In order to prevent the coolant from boiling, the cooling system is designed to be pressurized, under pressure the boiling point of coolant is raised considerably. However, too much pressure will cause hose and other parts to burst, so a system is needed to relieve pressure if it exceeds a certain point and this is job of radiator cap.

REMOVAL/INSTALLATION OF THE COOLANT PUMP

Removal;

- I switch-off the ignition and allow the engine to cool down.
- I drained the coolant from the radiator and coolant over-flow tank.
- I detached the belt driving the coolant pump.
- I removed the coolant pump pulley by loosening the bolts holding it in place. Mostly used an E12 socket and ratchet handle.
- I detached the coolant hose from coolant pump.
- I then loosen all the bolts holding the coolant pump using E10, E12, E14 or appropriate spanners accordingly.
- I used a long screw driver to pull out the coolant pump which has stick to engine body as a result of bonding formed by the seal.
- I finally cleaned the surface and replaced the seal.

Installation;

- I fixed the coolant pump seal.
- I then installed the coolant pump and tightened all the loosed bolts using appropriate tools.
- I fixed back the coolant hose and coolant pump pulley
- I replaced the engine belt and added coolant to the coolant tank filling it up to the appropriate level.

Precautions;

- I avoided working on the engine when the engine is still running.
- I ensure that I only open the coolant expansion tank when the temperature and pressure are low, that is when the engine cooled down.
- I ensure that all bolt and nut a properly tightened and the belt installed in the right direction.

REMOVAL/INSTALLATION OF RADIATOR

- I allowed the engine to cool down.
- I removed the engine bottom protector.
- I drained the coolant in the radiator into a clean bucket using a pair of pliers to remove the clip and detached the coolant hoses.
- I removed the oil pipes connecting to the radiator.
- I disconnected all the coolant hoses to the radiator ranging from the hose connecting to the coolant pump, the one connecting to the coolant expansion tank and the hose connecting to the thermostat.
- I disconnected the cooling fan electric socket and took the entire fan out to create working space
- I than removed the radiator bracket, and the radiator upper cross member.
- I pulled out the air ducting.
- I loosened the radiator bolts.
- And disconnected the AC condenser pipes if necessary.
- I unclipped the condenser using long nose pliers on bolt side of the radiator.
- I separated the condenser from the radiator and pull out the radiator.

- I installed the radiator in the reverse order.
- I finally checked the coolant level in the expansion tank and adjusted to the correct level.

REMOVAL/INSTALLATION OF ENGINE FAN

Removal;

- I switched off the car ignition
- I removed engine bottom sand protector.
- I disconnected the fan electric connector.
- I drained the radiator coolant.
- Then, I removed the engine top cover.
- I removed the upper radiator cross member
- I then detached the radiator hose.
- I remove the clamps on the left and right of the fan shroud
- I pull out the fan shroud from the top.

Installation;

- The fan was installed in the reverse order by which it was removed

Precaution;

- I ensured that the engine ignition was switched off before the job commenced.

- After switching the ignition off, I first disconnect the fan electrical connector because some vehicle fan can start rotating at any time even if the engine ignition is switched off.

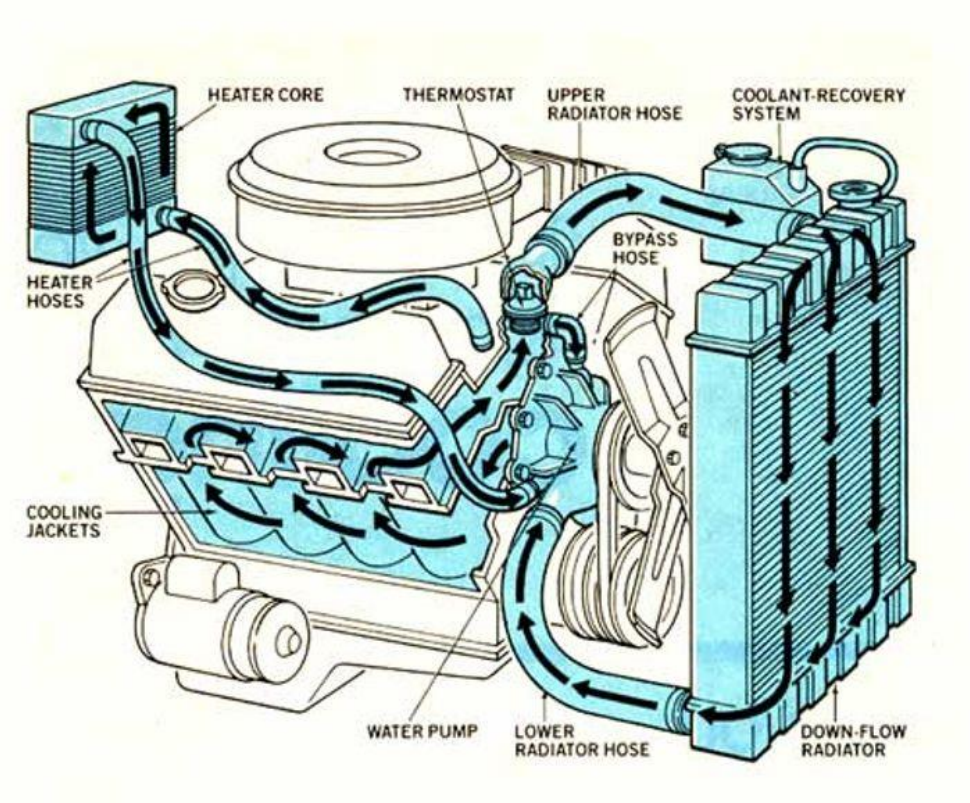


Fig.2.13 **Cooling system of a vehicle**

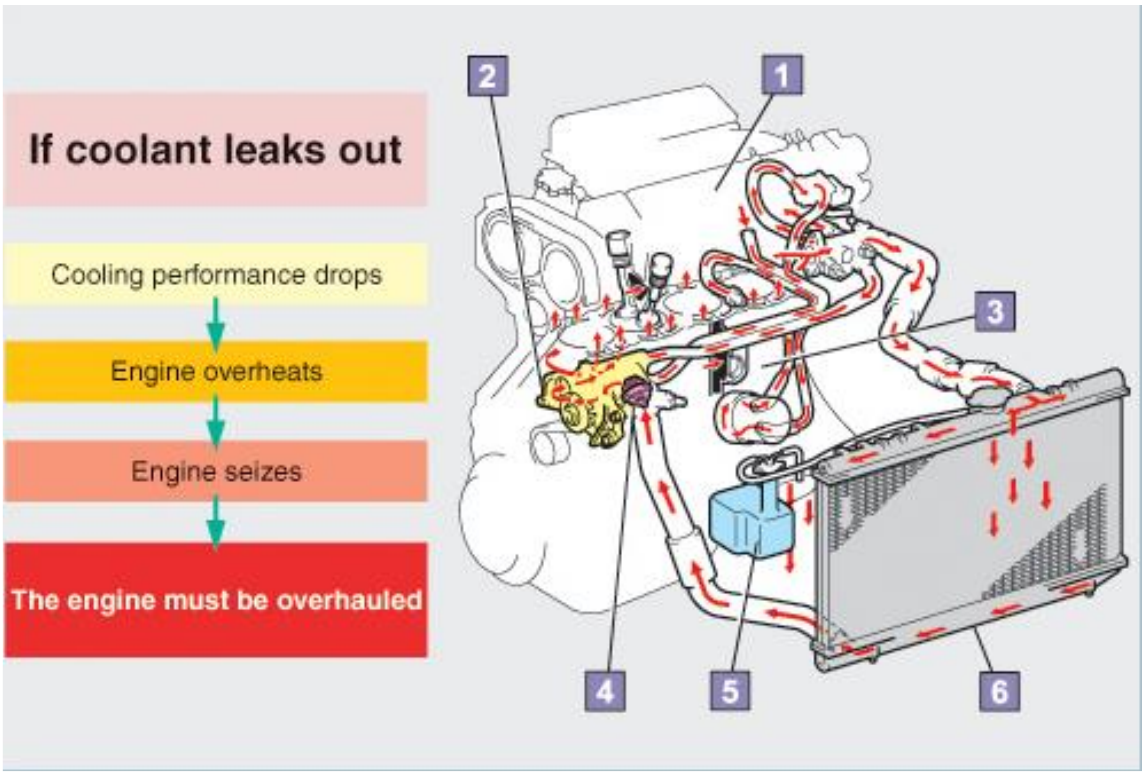


Fig. 2.130

This is what happens when coolant (water and it antifreeze) leaks out

1. **Cylinder Head**
2. **Water pump**
3. **Cylinder Block**
4. **Thermostat**
5. **Reservoir tank**
6. **Radiator**

2.14 TRANSMISSION SYSTEM AND SERVICE

A car transmission is simply the assembly of parts, including the gears and the propeller shaft that transmit the power from the engine to the axle.

It is broadly divided into the following classifications:

- FF (Front-engine Front-wheel drive vehicle)
- FR (Front-engine Rear-wheel drive vehicle)
- Manual transmission
- Automatic transmission

HINT:

In addition to FF and FR, there are 4WD (4-Wheel Drive) and MR (Midship engine Rear-wheel drive) vehicles.

Main components of a transmission are:

Transmission Control Modules: one of the main part of a transmission is transmission control modules, it controls the automatic transmissions, but is nonexistent in manual transmissions.

Transmission Filters: Another important component of transmissions is filters. Transmission depend on transmission fluid, s coolant that allows the clutch to engage and disengage, gears to change, valves to open and close, and so on. The filters ensures that any outside particles or substances are not mixed in with the fluid.

Transmission shafts: transmissions are also connected to the engine crankshaft by means of a flywheel, since the combustion engine inside the transmission cannot go below a particular speed. Therefore, the output of the transmission is done via the driveshaft, hence the name drive

wheels of a car.

Manual Vs Automatic Transmission

Manual transmissions typically run longer and are cheaper to fix and repair when compared to automatic transmissions. Nonetheless, many people still prefer automatic transmission because of their ease of use. Manual transmissions are more affordable and more traditional as well. We'll dive into the various factors with the cost of repairing or replacing a transmission later, as well as many problems that can result, which will require you to repair or replace them. After all, transmissions are not everlasting and like any part of the car, they need fixing on time or another and it's better to do it when you know approximately what is required and how much it will cost you.

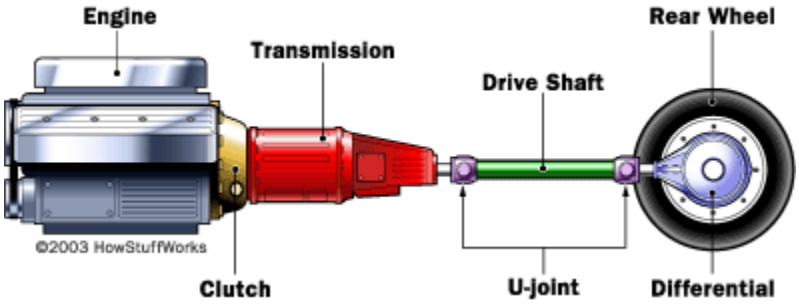


Fig. 2.14 **Transmission system of a vehicle**

AUTOMATIC TRANSMISSION FLUID AND OIL FILTER CHANGE.

Removal;

- The vehicle was placed on the lift and lifted up to a suitable height.
- I loosened the transmission sump protector.

- I drained the transmission fluid by loosen and removing the drain plug bolt.
- I then loosened the sump and removed the *ATF* oil filter.

Installation;

- I installed a new filter or washed the oil one depending on the customer decision.
- I fixed a new O-ring
- I applied silicone gel gum on the surface of the sump cover along the seal to prevent fluid leakage.
- I then installed the sump cover with the drain plug tightened
- I finally filled the sump with the appropriate transmission oil starting the engine at interval to allow the torque converter collect oil to itself.

Precautions;

- I avoided direct contact with the transmission oil especially used hydraulic fluid.

REMOVAL OF DRIVE SHAFT

- I supported the front of the vehicle on an axle stand
- I removed the wheel
- I slack the nut holding the shaft with appropriate size of socket and suitable extension
- I removed the brake pad and caliper
- I removed the tie-rod end from the steering knuckle
- I loosed the stabilizer link
- I loosed the steering knuckle
- I then unscrewed the already slacked nut holding the drive shaft to the hub

- I removed the drive shaft from the hub by bending the outer CV-joint *(constant velocity universal joint)*
- I then used a big chisel to remove the inner CV-joint from the gear box or transaxle.
- I finally pulled out the drive shaft

REMOVAL OF PROPELLER SHAFT

- I supported the vehicle on a lift or axle stand
- I neutralized the transmission system
- I loosed the underneath heat protector for the propeller
- We loosed all bolt holding the end of the propeller shafts to the front and back axle
- We then brought down the propeller shaft**.**

2.15 BRAKING SYSTEM AND SERVICE

An automatic braking system is a group of mechanical, electronic and hydraulic activated components which use friction/heat to stop a moving vehicle.

How the automotive Braking System works:

When the brake pedal is depressed the pressure on the brake pedal moves a piston in the master cylinder, forcing the brake fluid from the master cylinder through the brake lines and flexible hoses to the calipers and wheel cylinders. The force applied to the brake pedal produces a proportional force on each of the pistons. The calipers and wheel cylinders contain pistons, which are connected to a disc brake pad or brake shoe. Each output piston pushes the attached friction material against the surface of the rotor or wall of the brake drum, thus slowing down the rotation of the wheel. When the pressure on the pedal is released, the pads and shoes return to their release positions. This action forces the brake fluid back through the flexible hose and

tubing to the master cylinder.

Component of Automotive Braking System

- **Brake Disc**: brake disc are comprised of a disc or rotor, a caliper assembly, disc brake pads and the wheel bearings and hardware necessary to mount the components on the here it is created through hydraulic lines to the vehicle. The caliper is connected to the master cylinder through tubes, hoses and valves that conduct brake fluid through the system.
- **Brake Drum**: brake drums are comprised of a drum and backing plate, a hub or axle assembly, brake shoes, wheel cylinder, wheel bearings and hardware necessary to mount these components on the vehicle. The wheel cylinder is connected to the master cylinder through tubes, hoses and valves that conduct brake fluid through the system.
- **Brake Fluid**: Brake fluid is a type of hydraulic fluid used in brake applications for automobiles and light trucks. It is used to transfer force under pressure from where it is created through hydraulic lines to the braking mechanism near the wheels. Braking applications produce a lot of heat so brake fluid must have a high boiling point to remain effective and must not freeze under operating conditions.

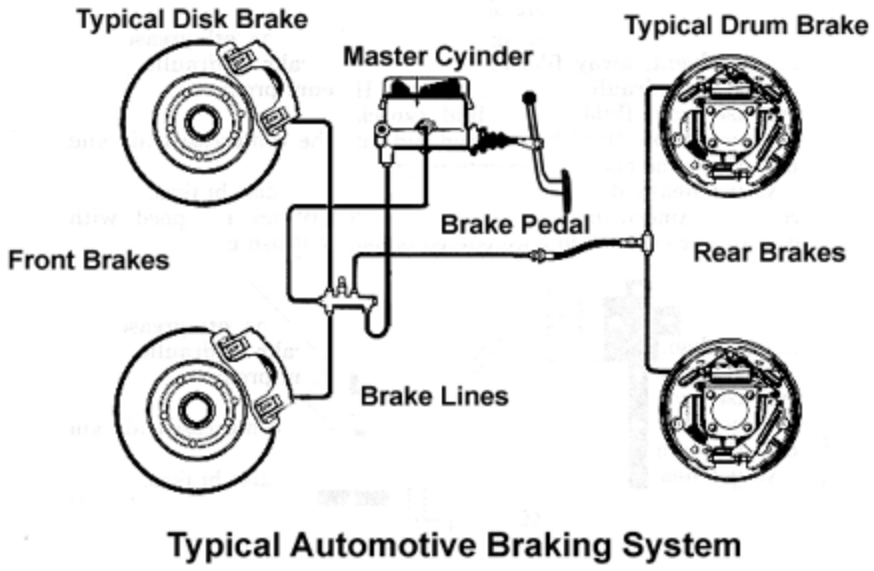


Fig 2.15

REMOVAL/INSTALLATION OF BRAKE PAD AND BRAKE CALLIPER

- First, I slack the wheel nuts and jacked the vehicle up to lift the wheel from the ground.
- I removed the wheel and support the vehicle with a safety stand.
- I disconnected the socket for the brake pad ware sensor.
- I removed the protective clips and used the appropriate wrench to lose the bolts of the caliper cover (different manufactures with deferent caliper cover bolts, it varies from 13mm, 14mm, 17mm, 19mm to alien bolts)
- After I loosed the brake disc caliper cover, I then removed the brake caliper cover and brake pad. In cases where the brake pad is stiffed to the caliper body I used a long flat screw driver to remove it.
- I then installed a new brake pad or resurface the old one with sand paper, depending on the level of brake lining on the brake pad and the customer decision.

Checking;

- I checked the brake pad thickness and the condition of the brake disc
- I examined the brake pad ware sensor and the guiding bolts
- I examined also the brake caliper and serviced it if required. After this I proceeded in installing a new brake pad.

Installation;

- I fixed new/resurfaced brake pad to position
- I then fixed the brake caliper cover to the caliper and tightened the loose bolts using the appropriate wrench.
- I installed the brake pad ware sensor and socket it back to position and tightened all protective clips.
- I fixed the wheel, removed the safety stand, jacked down the vehicle and ensure the wheel nuts are well tightened.

Precautions;

- After the job is completed I operated the brake pedal several times without starting the engine until the pressure in the brake line build-up.
- I avoided direct contact with the brake fluid.
- I used hand glove when working on a hot caliper.
- I checked brake fluid level and top it up if necessary.

REMOVAL AND INSTALLATION OF BRAKE DISC

Removal;

- I released the parking/emergency brake.
- I suspended the vehicle on a safety stand.
- I removed the tire and detached the brake caliper with the brake pad.
- I then unscrewed the brake disc bolt with the appropriate wrench.
- I finally removed the brake disc.

Checking;

- I examined the brake disc surface for smoothness and evenness.
- I then redressed the brake disc surface and fit back the brake disc, applying lubricant on the brake disc seat.

Installation;

- Installation of the brake disc was done in reverse order but applying lubricant to each bolt before retightening.

Precautions;

- I ensure proper use of tools.
- I handle the brake disc with care to prevent surface damage

2.16 FUEL SYSTEM AND SERVICE

The fuel system is critical in storing and delivering the gasoline or diesel fuel your engine needs to run. Think of it as your vascular system, with a heart (fuel pump), veins (fuel lines) and kidneys (filter). A failure in any of these fuel system component has the same devastating effects as in your body.

Components of the fuel system

Fuel tank: basically a holding tank for your fuel. When you fill up at a gas station the gas travels down the filter tube and into the tank. In the tank there is a sending unit which tells the gas gauge how much gas is in the tank. Some fuel thank houses the fuel pump and has more emissions controls to prevent vapors leaking into the gas.

Fuel pump: on newer cars the fuel pump is usually installed in the fuel tank. Older cars have the fuel pump attached to the engine or on the frame rail between the tank and the engine. If the pump is in the tank or the frame rail then it id electric and is driven by your car battery. Fuel pumps mounted to the engine use the motion of the engine to pump the fuel, most often being driven by the camshaft, but sometimes the crankshaft.

Fuel filter: clean fuel is critical to engine life and performance. Fuel injectors and carburetors have tiny openings which clog easily so filtering the fuel is a necessity. Filters can be before or after the fuel pump. They are most often made from a paper element, but can be stainless steel or synthetic material and are designed to be disposable in most cases. Some performance fuel filters will have washable mesh, which eliminated the need for replacement.

Fuel Injector: The fuel-injector system supplies the engine with a combustible air-fuel mixture. It varies the richness of the mixture to suit different operating conditions. When a cold engine is started, the fuel system delivers a very rich mixture. This has a high proportion of fuel. After engine warms up, the fuel system "lean out" the mixture. It then has a lower proportion of fuel. For acceleration and high speed, the mixture is again enriched.

REMOVAL/INSTALLATION OF INJECTOR VALVES

Removal;

- I switched off the ignition
- I removed the engine cover
- In some engine installation especially multiple cylinder engines and 'V' engines I do remove the inlet manifold to have access to the fuel injector.
- I disconnect the electric sockets to each injector valve.
- I detached the fuel supply line to the fuel rail
- I loosened the nut holding the fuel rail and injector valves in place.
- I then pulled the injector valves and fuel rail out of the engine
- I removed the securing clamps from each injector valve
- I finally removed the injector valves from the fuel rail and removed the O- ring from each injector valve.

SERVICING OF FUEL INJECTOR VALVES

Servicing of the injector valves is necessary when the ECM registered a misfiring on scan tool, this misfiring may be as a result of small-tiny particle carried along the fuel line to the injector valves and accumulating over time or as result of carbon deposits at the tip of the

injector valves. This prevents free and timely delivery of fuel thereby resulting in a misfire. This service is done with carburetor cleaner to wipe out the carbon deposits and flush out dirt in the injector valve. The method is called the battery method.

INJECTOR VALVES SERVICE USING THE BATTERY METHOD

- A socket with two output terminal was connected to the injector valves with one output terminal connected to the negative terminal of a 12 volt battery.
- The carburetor cleaner was then inserted to the top of the injector valve connected by a straw.
- The second terminal was used to strike the positive terminal of the battery at interval as the carburetor cleaner was operated simultaneously.
- When the positive terminal is connected the injector valve open allowing the carburetor cleaner to flush out the dirt.
- The injector valve was then cleaned with a clean soft rag.
- Other method involves the shocking of the injector valves in DOT 3 fluid for eight to twelve hours or overnight.
- Then clean the valve and install it.

Installation;

- I replaced the O-rings if damaged
- I slide the securing clamps on each fuel injector valve
- I then applied engine oil on the O-ring to prevent damage when inserting the injector valve
- I then insert the injector valve with the fuel rail into position

- I tightened all nut holding it and connected the fuel supply line.

Precautions;

- I avoid the use of any material that can ignite fire
- I remove the fuel supply line with care because the fuel line is pressurized.

REMOVAL/INSTALLATION OF FUEL TANK

- I lifted the car to a suitable height
- I drained the fuel by loosening the drain plug and collect the fuel in close container
- We then disconnect the underfloor paneling on the fuel tank
- We removed the exhaust pipe and propeller shafts
- We detached the filler neck from the fuel tank
- We disconnected the feedline and return line
- We then support the fuel tank with the standing jack
- We then loosed the bolt holding the fuel tank in place
- We lower the fuel tank slightly and disconnected all electrical sockets
- We finally lowered the fuel tank to the ground
- The fuel tank was installed in the reverse order

Checking;

- We washed the fuel tank and inspect for leakages

Precautions;

- We ensured that the vehicle properly balanced on the lift

- We ensured that the fuel tank was empty and the weight supported by the standing jack

FUEL FILTER CHANGE/SERVICE

- I switched the ignition off
- I removed the back seat covering the maintenance access covers
- I opened the maintenance access cover and disconnected the power supply socket to the pump and disconnected the gauge and sensor.
- I disconnected the fuel feed line and return line
- I disconnected the ground terminal from the battery
- We then open the fuel filter lock using the fuel pump wrench, long big screw driver and hammer
- I pull out the fuel filter from the left side of chamber of the fuel tank
- A new fuel filter was installed in the reverse order.

REPLACEMENT OF FUEL PUMP

- I switched off the ignition
- I removed the back seat
- I opened the maintenance access cover for the fuel pump. Usually for vehicle with two maintenance access point. The right side when facing the front of the vehicle is the fuel pump while the left is the fuel filter.
- I disconnected the ground terminals of the battery
- I also disconnected the fuel feed line, return line, socket for electric power supply to the fuel pump and gauge.

- We loosed the fuel pump lock using the round fuel pump wrench, long big screw driver and hammer.
- I then pull out the fuel pump
- I installed the new fuel pump in the reverse order.

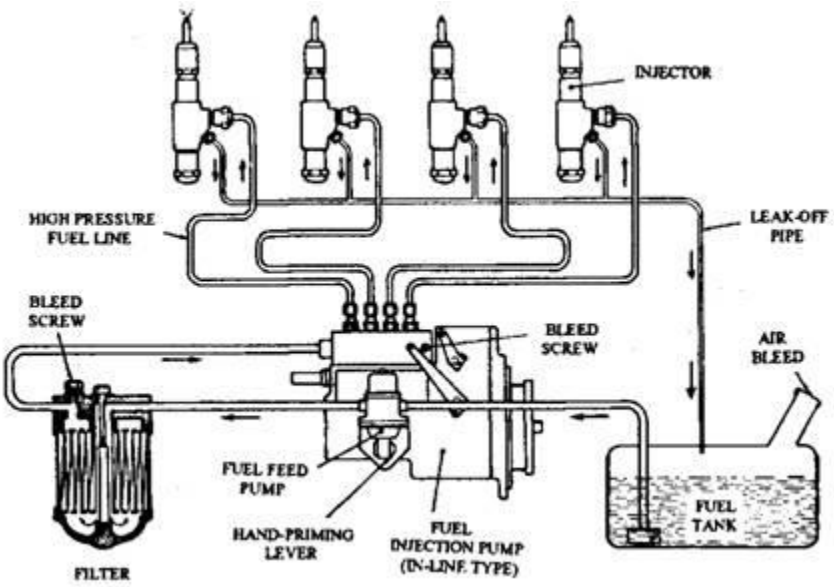


Fig. 2.16 **Fueling system of a vehicle**

2.17 SUSPENSION SYSTEM AND SERVICE

Suspension is the term given to the system of shock absorbers and linkages that connect a car to its wheels. The suspension system has two basic functions: 1) to keep the car's wheels in firm contact with the road to provide the traction and 2) to provide a comfortable ride for the passengers and isolate them from road noise, bumps and vibrations.

Components of the suspension system

The basic components of a suspension system are as follows:

- Control Arms and Bushing: holds the steering knuckle, bearing support, or axle housing

in position, as the wheel moves up and down. The outer end of the control arm has a ball joint and inner end has bushings. Vehicles, having control arm on the rear suspensions may have bushings at both ends. The control arm bushing act as bearings, which allows the control arm to move up and down the shaft bolted to the frame or suspension unit.

- Shock Absorbers and Struts: shock absorbers are necessary because springs do not settle down fast enough. After the spring has been compressed and released. It continues to shorten and lengthen for a time, such spring action on a vehicle would produce a very bumpy and uncomfortable ride. It would also be dangerous because a bouncing wheel makes the vehicle difficult to control; therefore a dampening device is needed to control the spring.
- Ball Joints: the ball joints are connections that allow limited rotation in every direction and support the weight of the vehicle. They are used at the outer ends of the control arm where arms attach to the steering knuckle. In operation, the swiveling action of the ball joints allows the wheel and steering knuckle to be turned left or right and to move up and down with changes in road surface.
- Strut Rods: the strut road fastens to the outer end of the lower control arm and to the frame. This prevents the control arm form swinging toward the rear or front of the vehicle. The front of the strut rod has rubber bushings that soften the action of the strut rod. These bushings allow a controlled amount of lower control arm movement while allowing suspension to travel.
- Stabilizer bar: limits body roll of the vehicle during cornering
- Spring: supports the weight of the vehicle, permits the control ram and wheel to move up and down, also helps in isolation of vibration.

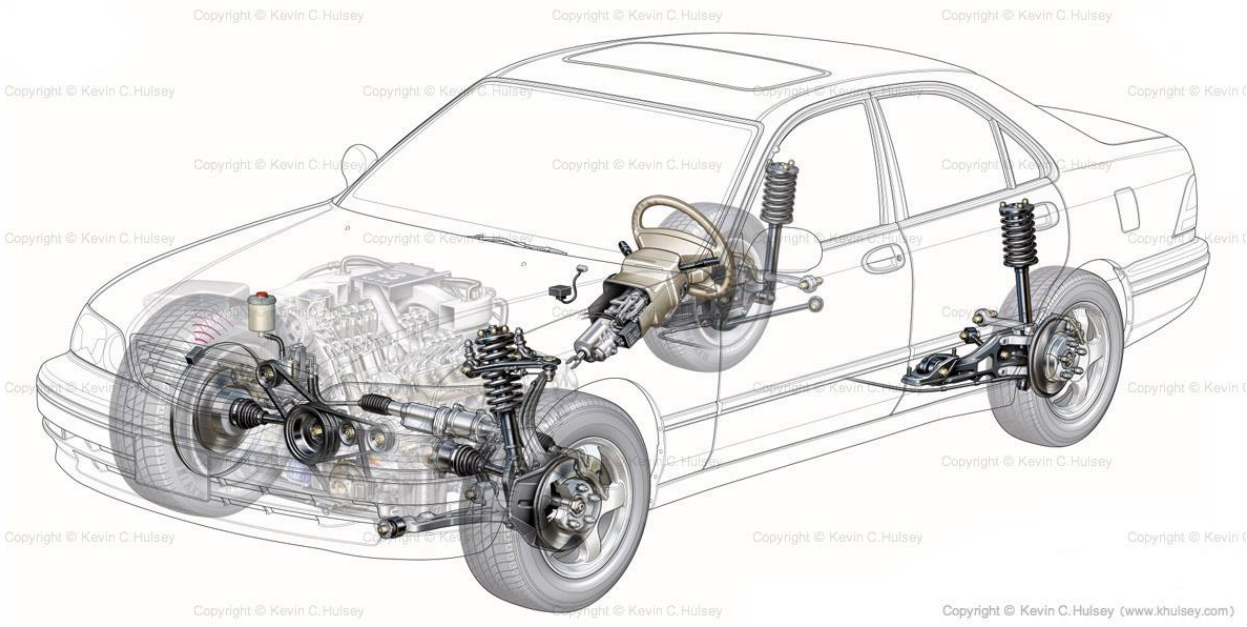


Fig.2.17 **Suspension System of a Vehicle**

REMOVAL AND INSTALLATION OF SUSPENTION STRUT

Removal;

- I suspended the consigned side of the vehicle and removed the wheel.
- I removed the brake caliper and brake pad from the steering knuckle.
- I opened the hood and slack the nut holding the strut mount to the vehicle body and left the upper portion of the absorber in place for support.
- I loosened the stabilizer link from the absorber.
- I loosen the ball joint and tie-rod end so as to freely rotate the steering knuckle.
- I then loosen the knuckle bolt and nut, and removed them from the steering knuckle.
- I loosened completely the already slacked nut on the hood.
- I finally rotate the steering knuckle to one side and removed the strut.

- I installed the strut on a spring compressor and compressed the spring.
- I loosened the strut rod nut and removed the strut tower and strut.
- I then release gentle the spring compressor.

Checking;

- After complete removal, I examined the condition of the suspension strut, paying attention to the strut rod for oil leakage.
- I manually compressed the strut rod to the lowest position and examined the manner with which it returns back up.
- I also checked the spring for crack or breakage.
- For air spring suspension I checked the air valve unit for leakage. The air valve distributes air to the four air spring suspension.
- I also examined the air compressor and replaced if found faulty.

Installation;

- I installed the suspension strut in reverse order to how it was removed.
- I then guided the strut attaching nut holding the top of the strut.
- I retightened the knuckle bolt, ball joint and stabilizer link.
- I re-installed the brake caliper and brake pad.
- I finally fixed the wheel and removed the vehicle from suspension.

2.18 STEERING SYSTEM AND SERVICE

The direction of motion of a motor vehicle is controlled to a desired direction steering system. When the driver turns the steering wheel, a shaft from the steering column turns a steering gear. The steering gear moves tie rods that connect to the front wheels. The tie rods move the front wheels to the vehicle right or left.

Today, there are two types of steering systems: 1) standard mechanical (reciprocating ball) steering and 2) rack and pinion steering. The standard mechanical steering can be either power-assisted or non- power. Rack and pinion is almost always power assisted, although there are cases where it is not.

Standard mechanical (reciprocating ball) steering: The steering wheel is connected to the steering box through the steering column. The steering box turns the rotation of the steering wheel 90^{o} and, in the case of power steering, uses high-pressure fluid to help actuate the steering. The steering box has an arm attached to the output shaft called the pitman arm. This connects the steering to the steering gear. The pitman arm is connected to one end of the center link (drag link). On the other end of the center link is an idler arm. Between the idler and pitman arms, the drag link is supported in the proper position to keep the left and right wheels working together. The inner tie rod ends are attached to each end of the center link and provide points for the steering gear. From there it goes to the outer tie rod ends through an adjustment sleeve. This sleeve joins the inner and outer tie rod ends together and allows for adjustment when the front wheels are aligned. The outer tie rods ends are connected to the steering knuckle that actually turns the front wheels. The steering knuckle has an upper and lower ball joint on which it pivots and creates the geometry of the steering axis.

Rack and pinion steering: Rack and pinion steering, on the other hand, basically combines the steering box and drag link into one unit. The steering wheel, through the steering column, is directly connected to the track. Inside the steering rack is a pinion assembly that moves a toothed piston which in turn moves the steering gear. One end of the inner tie rod ends is connected to each of this piston and the other end is connected directly to the outer toe rod end. The inner tie rod end is actually threaded into the outer tie rod end and can be rotated to make adjustments during a wheel alignment.

The advantage of rack and pinion steering is that it's more precise than mechanical system. By reducing the number of parts and pivot points, it can more accurately control wheel direction, making the steering move responsive. The disadvantage of a rack and pinion steering system is that it's prone to leakage, requiring replacement of the steering rack assembly.

Components of steering system

- Power Steering fluid reservoir
- Power Steering Pump
- Rack and Pinion steering gear
- Steering Wheel
- Pitman Arm
- Steering Box
- Tie rod/Track rod
- Steering Column and Knuckle
- Drag Link
- Steering Shaft

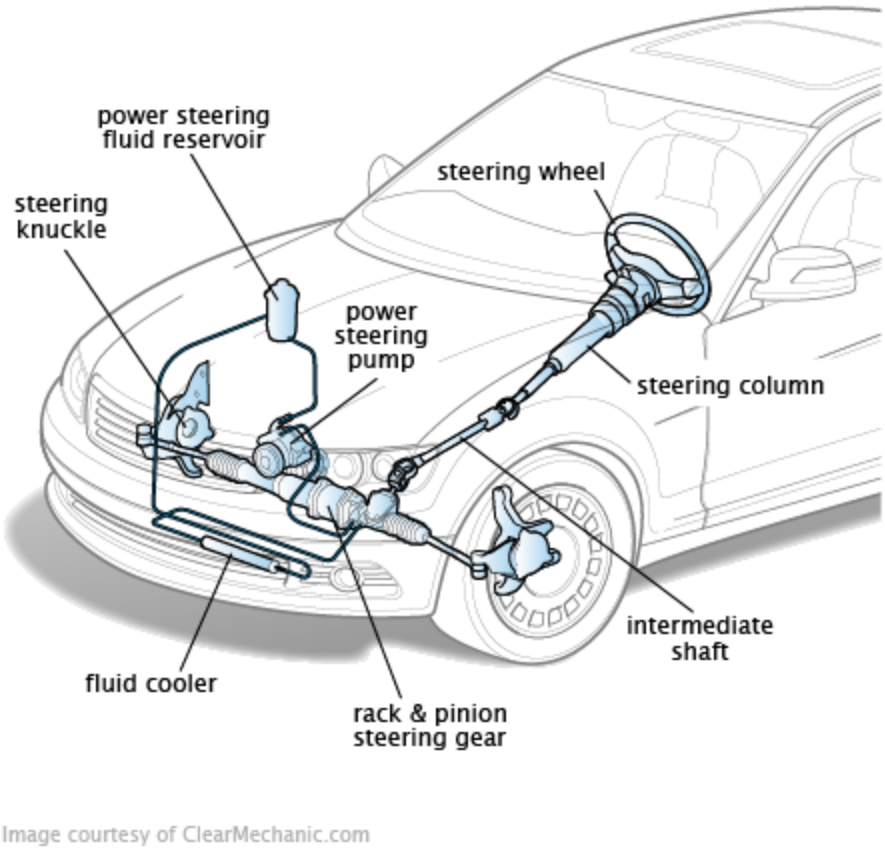


Fig. 2.18 **Steering System of a Vehicle**

REMOVAL/INSTALLATION OF POWER-STEERING PUMP

Removal

- I switch off the ignition of the car.
- I extracted the power steering fluid from the power steering fluid reservoir.
- I disconnected all electric sockets.
- I detached all hose connected to the power steering pump.
- I removed the drive belt supplying power to the power steering pump.
- I loosened all bolt holding the pump in place and removed the power steering with the bracket.

Installation;

- I examined the power steering pump for damages, changed it if necessary
- I fixed the power steering pump with bracket and tightened all the necessary bolt
- I fixed back all hose connected to the pump and installed the belt
- I then fixed the power steering fluid reservoir and connect all electrical socket
- I filled the reservoir with transmission fluid up to the appropriate level
- I bleed the fluid line to remove trap-air

Precaution;

- I avoided skin contact with the fluid to prevent skin and eye irritations
- I allowed the engine to cool down before commencing the job.

ELETRICAL SYSTEM OF VECHICLE

2.2 CHARGING SYSTEM

The purpose of the charging system is to maintain the charge in the vehicle's battery, and to provide the main source of electrical energy while the engine is running. If the charging system stopped working, the battery's charge would soon be depleted, leaving the car with a "dead battery."

If the battery is weak and the alternator is not working, the engine may not have enough electrical current to fire the spark plugs, so the engine will stop running.

The battery is a rechargeable device that serves as a power supply for the electrical parts when the engine is stopped. When the engine is running, it stores the used electricity.

HINT:

A battery inspection consists of checking the level and the specific density of the electrolyte.

CAUTION:

The following precautions must be taken when handling a battery:

- Keep it away from fire during charging, because hydrogen gas is emitted.
- Keep the electrolyte, in which the sulfuric acid is used, away from your body, clothes or the vehicle body.

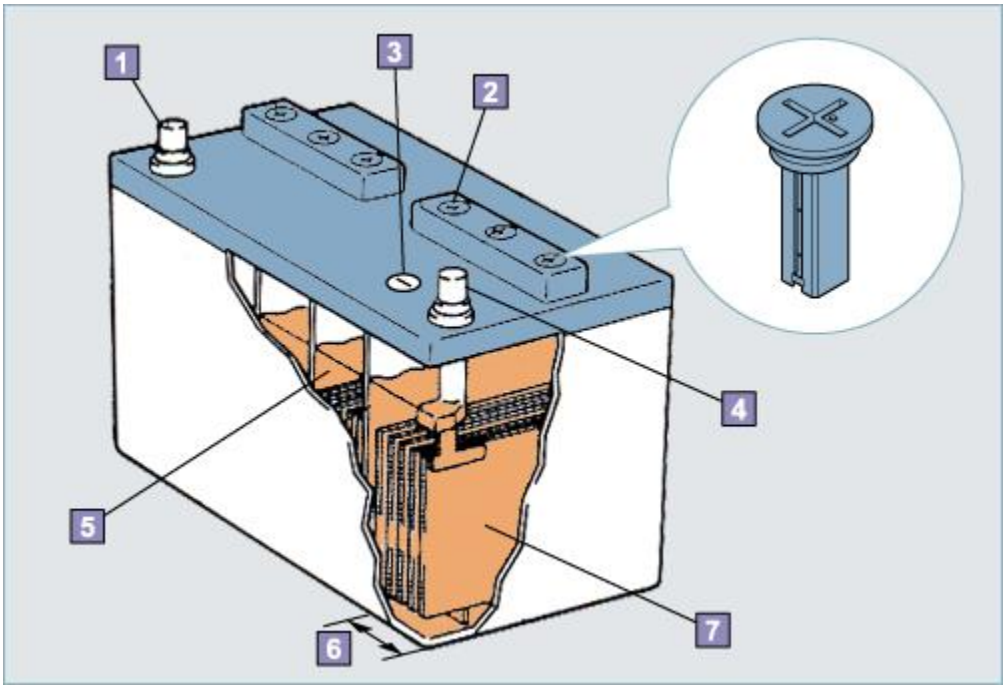


Fig. 2.21

1. Negative terminal
2. Vent plug
3. Indicator

4. Positive terminal
5. Electrolyte
6. Cell
7. Pole plate

Charging and discharging principle

A battery charges and discharges electrical energy through the chemical reaction of the electrolyte.

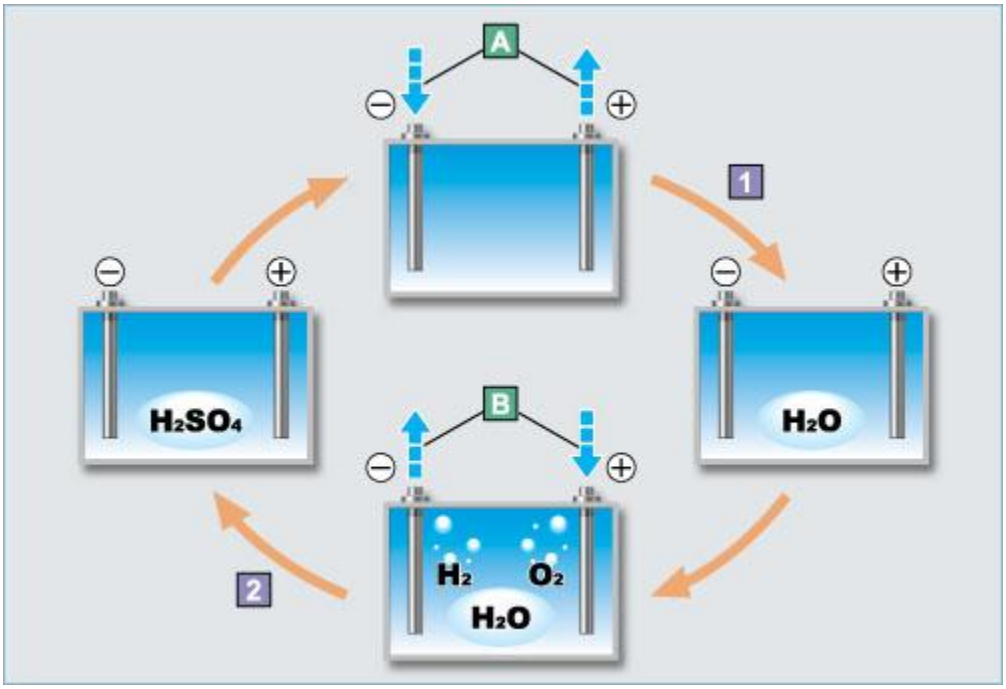


Fig. 2.22

1 Discharging

2 Charging

A Discharging amperage

B Charging amperage

HINT:

When a chemical reaction (electrolysis of water) occurs in the electrolyte during

charging, the positive pole plates generate oxygen and the negative pole plates generate hydrogen. Due to the electrolysis of water, the volume of the electrolyte decreases, thus requiring replenishment.

If the battery is "dead", it does not necessarily mean that there is anything wrong with it. It is just depleted of its charge. It can be brought back to life by recharging it with a battery charger, or by running the engine so that the alternator can charge it.

The main component in the charging system is the ALTERNATOR. The alternator is a generator that produces Alternating Current (AC), similar to the electrical current in your home. This current is immediately converted to Direct Current (DC) inside the alternator. This is because all modern automobiles have a 12 volt, DC electrical system.

A VOLTAGE REGULATOR regulates the charging voltage that the alternator produces, keeping it between 13.5 and 14.5 volts to protect the electrical components throughout the vehicle.

There is also a system to warn the driver if something is not right with the charging system. This could be a dash mounted voltmeter, an ammeter, or more commonly, a warning lamp. This lamp is variously labeled "Gen" Bat" and "Alt.". If this warning lamp lights up while the engine is running, it means that there is a problem in the charging system, usually an alternator that has stopped working. The most common cause is a broken alternator drive belt.

The alternator is driven by a belt that is powered by the rotation of the engine. This belt goes around a pulley connected to the front of the engine's crankshaft and is usually responsible for driving a number of other components including the water pump, power steering pump and air conditioning compressor. On some engines, there is more than one belt and the task of driving

these components is divided between them. These belts are usually referred to as: Fan Belt, Alternator Belt, Drive Belt, Power Steering Belt, A/C Belt, etc. More common on late model engines, one belt, called a Serpentine Belt will snake around the front of the engine and drive all the components by itself.

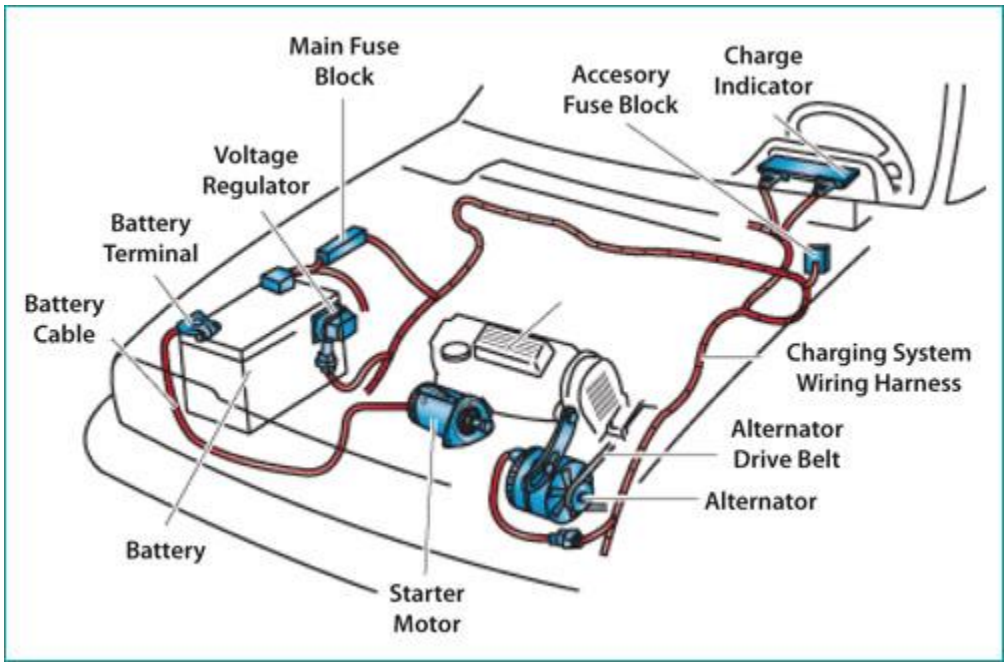


Fig. 2.23 **Charging System of a Vehicle**

2.3 JUMP STARTING

Jump starting is starting the engine of a vehicle that has a dead battery by using a charged battery, usually in another vehicle. The charged battery is the booster battery. Try to avoid jump starting. It is dangerous when performed incorrectly. Sparks may cause explosion. In addition, sparks and improper connections may damage electrical and electronic equipment on the vehicle.

Follow the jump start procedure in the vehicle owner's manual. Also, follow the safety cautions for working safely around batteries. The jump start procedure requires a set of two

jumper cables. These are lengths of heavy gauge insulated cable with spring loaded clamps on the ends. One cable is black. The other is usually red.

Procedures;

- I moved the vehicle with the charged battery close to the vehicle with the dead battery. I do not allow the vehicle to torch each other.
- I checked the jumper cables are long enough to reach from battery to battery.
- I set the parking brake in both vehicles. The transmissions in both vehicle should be in PARK (automatic) or NEUTRAL (manual).
- I turned off all lights, switches and electrical equipment
- On some vehicle with an antilock-braking system (ABS),I disabled the antilock system. This may require disconnecting the ABS wiring-harness connector, removing the ABS power relay, or removing the ABS fusible link from near the battery positive terminal. The procedure is in the vehicle owner manual and service manual.
- I connected one end of the red (positive) jumper cable to the positive (+) terminal of the dead battery. I connected the other end of this jumper cable to the positive terminal of the charged battery.
- I connected one end of the black (negative) jumper cable to the negative (-) terminal of the charged battery.
- I connected the other end of the black (negative) jumper cable to the engine block or a head bolt at least 450mm away from the dead battery.
- I checked that the jumper cables are clear of the engine fan and other rotating parts.
- I started the engine in the vehicle that had the charged battery. I ran the engine at fast idle.

- I started the engine with the dead battery.
- I disconnected the black jumper cable from the engine block. Then I disconnected the other end of the cable.
- I finally disconnected the red jumper cable.

Precaution;

- I ensured that the jumper cable do not torch each other to avoid battery short circuit.
- I ensured I made the battery connections observing proper polarity− positive to positive, and negative to negative (parallel connection).
- I do not connect the jumper cable to the negative terminal of the dead battery. This prevents any sparks that occur from causing a battery explosion.

Repair and Maintenance Process Mechanical systems in automobiles are a little complex and some problems, may need to be serviced at the repaired shop.

2.4 KEY PROGRAMMING

Is the process of registering a key either as the master key or the sub key.

Before registering a key, the key must have been ordered and the new key part number must tally with the old key in other for it to work.

Procedures;

- You can only program another key if the master key is available
- Begin by entering into the driver side
- Open and close the driver door
- Remove key from ignition cylinder

- Insert and remove the key from the ignition key cylinder twice within 5 seconds
- Close and open the driver door twice within 40 seconds
- Insert the key into the ignition key cylinder and remove it
- Close and open the driver door twice within 40 seconds again
- Insert the key into the ignition key cylinder
- Close the door then turn the ignition switch from “lock” to “on” and back to “lock” at about one second interval
    - 1 time for ADD mode
    - 2 times for REWRITE mode
    - 3 times for CONFIRMATION mode
    - 5 times for PROHIBITION mode
- Remove the key from the ignition key cylinder
- To confirm your selection of all mode except CONFIRMATION mode, the power locks will now cycle “LOCK” to “UNLOCK” a number of times corresponding to your key cycles
- If CONFIRMATION mode has been selected, the power door locks will now circle (in 2 seconds intervals) a number of times corresponding to the numbers of transmitters currently registered, opening the door will complete the procedure.
- For ADD or REWRITE modes, within 20 seconds of door lock confirmation

- Press both transmitter “LOCK” and “UNLOCK” switches simultaneously between 1 and 1.5 seconds and release.
- Within 3 seconds of step (a) press the transmitter “LOCK” switch for more than 1 seconds and release.
- If the transmitter has been successfully programmed, the power locks will cycle “LOCK” to “UNLOCK” once at this time. If there are problems with the procedures used up to this point, the locks will cycle twice, in which case you must go back and repeat the above steps
- If multiple transmitters are to be programmed, repeat the above
- Open the driver’s door to complete the procedure

2.5 SAFETY INFORMATION

Most accidents in servicing/mechanical repair involve slips, trips and falls or poor manual handling. Other causes of incidents sometimes resulting in serious injury or death include working under inadequately supported vehicles, incidents involving petrol and vehicle movement. Keeping work areas free of clutter is an important, but often overlooked, step in running a safe and productive workshop. Requiring appropriate protective gear minimizes eye and finger lacerations, which are common auto body shop injuries. Shops should purchase appropriate eyewear, and make protective gloves available to prevent cuts from glass, sheet metal or other jagged objects.

2.6 TOOLS REQUIRED

- Tool box comprises of different types of wrench, screw drivers, hammers and pliers
- Car jack and car lift
- Axle/ safety stand
- Oil filter wrench
- Computer diagnostic tools
- Standing jack
- Oil drain
- Bench vice

TOOL BOX

Tool box is a safe and convenient box keeping and storing workshop tools such as; wrench of different types and sizes, screw drivers of different sizes, pliers of different types, punch, wire brush and other useful workshop tools.

FUNCTIONS;

- A wrench is a long-handle tool with fixed or adjustable jaw. We use the wrench to turn bolts, nuts, and screws. There are different types of wrench namely; open-end wrench, box wrench, combination wrench, flare-nut wrench, adjustable wrench, socket wrench and torque wrench. The socket wrenches are the most widely used tools in the shop.
- Screw drivers are used to drive or turn screws. Screw drivers are made in variety of sizes, shapes and special-purpose design. The most common type has a single fat blade for driving screws with slotted heads. Always select a screw driver of proper type and size for a given job. Commonly used are the Philip-head screwdrivers or slotted-head screwdrivers
- Hammer is a hand tool used for striking to fit object in place or break apart.
- Punch is used for making points on a metal surface or knock out rivets and pins. They are also used to align parts for assembly.
- Wire brush is used for cleaning rusted surfaces. It is also used for removing pant or carbon deposits on metallic surfaces.

Fig. 2.7 Tool box

CAR JACK AND LIFT

FUNCTIONS/DISCRIPTION;

The automotive shop uses a variety of hydraulic jacks. One type is the portable floor jack. Pumping the handle increases the pressure in the hydraulic cylinder. This causes the ram to extend and raise the lifting saddle. Turning the top of the handle or moving a level on the handle releases the pressure. Then the saddle and load settle back down.

Automotive lifts are in ground lifts or surface lifts. In ground lifts may be single-post, double-post or four-post. The three types require excavation of the ground for installation of

hydraulic cylinders. Moving the vehicle requires an air or electric motor to operate a hydraulic pump. It sends fluid under pressure to the hydraulic cylinder.

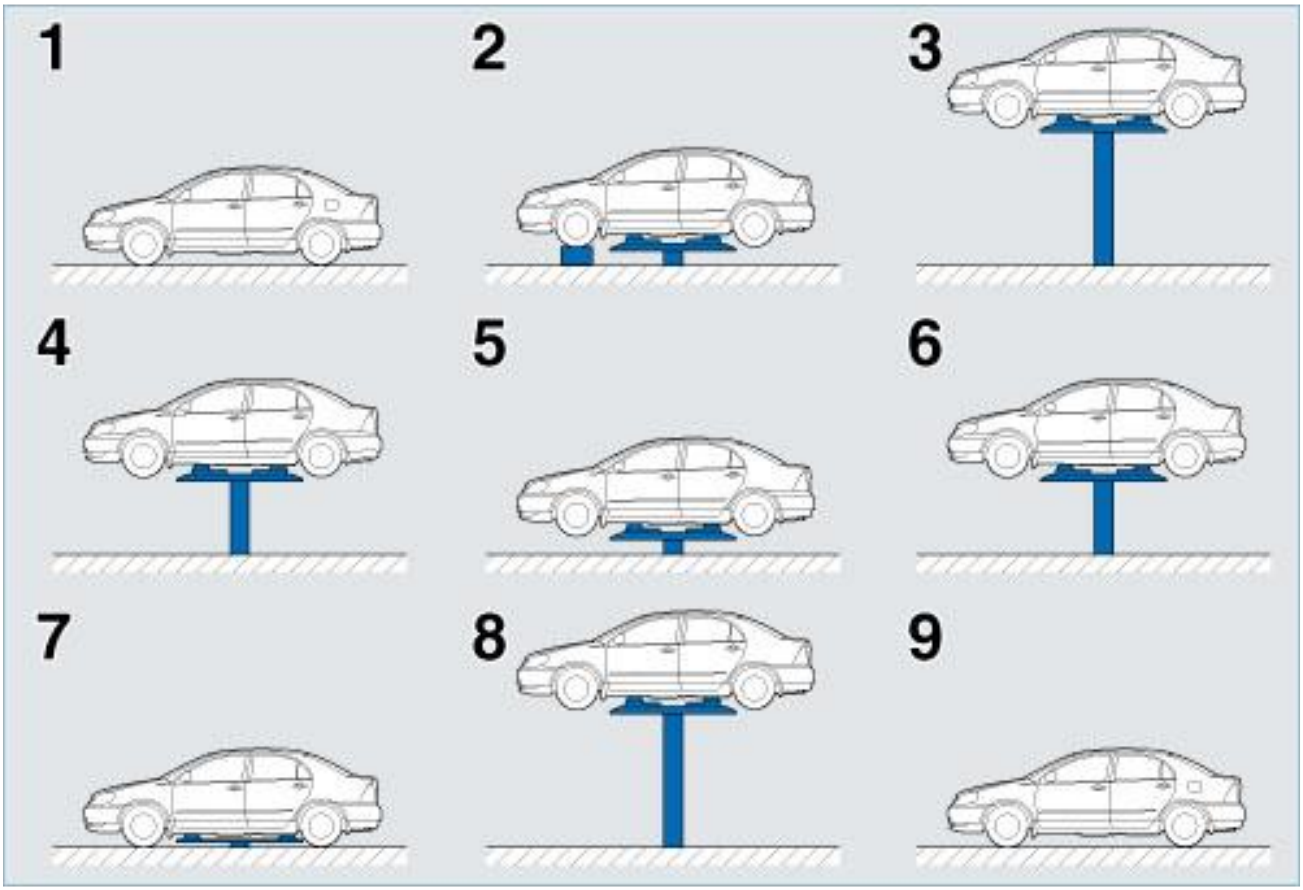


Fig. 2.8 showing different lift positions

Here is a description of the lines of work movements at the respective lift positions. As a rule, the 9 lift positions that are described here will enable the technician to complete all the operations.

Thus, an efficient inspection can be performed by minimizing the number of times the lift is operated in which each has its individual parts to inspect on

1. Lift position 1 (lift remains unraised); lights, windshield washers, horn, brakes, clutch, steering wheel, fuel tank cap, spare tire

2. Lift position 2 (lift raised low); ball joint

3. Lift position 3 (lift raised high); engine oil drain, M/T oil, A/T fluid, drive shaft boots, steering linkage, Manual steering gear, fuel line, exhaust pipes and mounting, nuts and bolts (under the vehicle), suspension, engine oil filter, engine oil drain plug.

4. Lift position 4 (lift raised medium); wheel bearing, wheel removal, tires, disc brakes, drum brakes.

5. Lift position 5 (lift raised low); brake drags, brake fluid changer installation.

6. Lift position 6 (lift raised medium); brake fluid replacement, wheel installation.

7. Lift position 7 (lift raised low, tires touching ground); Engine oil (fill), engine coolant, radiator cap, drive belt, brake fluid, brake lines, hub nuts retightening, PCV system, idle mixture, Air conditioning, valve clearance, fuel filter.

8. Lift position 8 (lift raised high); to perform a final check of the inspected arears (recheck), replaced parts, and oil and fluid leaks

9 Lift position 9 (lift remains unraised); clean the various arears of the vehicle and perform other car-care tasks

Fig. 2.9 a car lift

AXLE/SAFETY STAND

FUNCTIONS/DISCRIPTION;

- Axle stands are also known as safety or jack stands
- They support the jack after the vehicle has been raised to the desired height
- They also stand as a safety support in case the hydraulic jacks fails on load.
- Axle stand are specified in maximum height it can be extended and the load carrying capacity. We have 280mm and 420mm height specifications, and 2 TONNES, 3 TONNES, 4 TONNES AND 6 TONNES
- It has an adjustable and removable arm.

BENCH VICE

FUNCTIONS/DESCRIPTION;

- It is used to grip object so that work can be done on them
- It has two parallel gripping jaws; one is fixed while the other is movable.
- It also has a metal handle used to adjust the moving jaw

OIL DRAIN CONTAINER

FUNCTIONS/DISCRIPTION;

- It main purpose is to collect oil neatly during engine service, without allowing the oil to spill on the ground
- It also allow for easy and proper disposal of waste/spent oil
- It has a roller for easy movement from place to place in the shop
- It has height adjustment level to vary the height with respect to the vehicles height.

OIL FILTER WRENCH

FUNCTIONS AND DISCRIPTION;

- Oil filter wrenches are design for losing and tightening oil filters
- They are round with polygon like edge that fit perfectly into the bottom of the oil filter
- It has a socket hole
- It has an opening at the top for twisting by a short or long extension with a handle.

2.7 ACTIVITES DONE IN SPARE PARTS SECTION

SPARE PARTS STORE: a spare part store is a building such as a warehouse where goods needed for future use are kept. These goods stored in the warehouse can be called spare parts. A spare part, service part, repair part, or replacement part, is an interchangeable part that is kept in an inventory and used for the repair or replacement of failed units.

Fig. 2.5 showing a spare parts warehouse.

In spare parts management, it is necessary to ensure that parts brought into the warehouse/store are genuine parts and not counterfeit parts.

- **GENUINE PARTS:** genuine parts ensure that the vehicle retains its original manufacturer's status thus giving the vehicle owners great value for their money. It also ensures comfortable driving throughout the life span of the car. It prolongs the life span of the car and genuine parts are always warranty covered.

- **COUNTERFEIT PARTS:** counterfeit parts are products that use a trademark or copy a design illegally. They are products that, when sold, defraud the customer. There are some ways through which counterfeit parts can be detected;
    - **PACKAGE:** spelling of parts logo, typeface or font width of logo, rough finish.
    - **PRODUCT DESIGN:** shape or structure of product, position of manufacturer's name. Product is dirty.
    - **Wholesale or retail price is extremely low**
    - **Performance is inferior to that of genuine parts i.e.**
        - **Brake pads:** wears quickly, lacks durability, low braking force.
        - **Oil filter:** poor quality element, low filtration performance, short life.
        - **Air filter:** element has low filtration performance, short life.
        - **Spark plug:** low heat resistance, possibility of melting.
        - **Belts:** lack durability.
        - **Seal: breaks** easily, giving rise to leaks.
        - **Body parts:** do not fit the vehicle body tightly.

In the spare parts store, there are some operations that are carried out when dealing with spare parts;

a) Sorting: when new parts are received they are first sorted out according to the part number before binning them to the appropriate location.

b) Binning: after the parts have been sorted out then the parts are stored in bracket at different location according to how frequent the part are ordered, size, weight, and group of similar items

c) Picking: when a part is ordered, a list of the item is provided to the warehouse/spare part personnel, the order form contains the quantity, location, and part number which is then used to pick the requested item.

d) Dispatching: is the process of picking item ordered by another dealership usually in large amount,

   The item/part is then sent to the dealership which requested for the part

e) Maintenance: the process of cleaning the shelves and bracket which the parts are stored in to prevent it from dust, and other foreign material that might or will deteriorate the carton in which the item is packaged or stored and this is done periodically, once in every month.

CHAPTER 3

IMPLICATION OF THE TRAINING PROGRAMME/EVALUATION OF THE TRAINING PROGRAMME

3.0 INTERPLAY OF UNIVERSITY-TAUGHT COURSES

FLUID MECHANICS

The study of braking system in automobiles. A vehicle brake is used in vehicle to slow down its speed by converting its kinetic energy into heat. Actually the brakes transfer a force to the tyres due to friction and tyres in return transfer that force to the road also in the form of friction. The hydraulic system, most commonly used usually has six main stages: the brake pedal the brake boost (vacuum servo), the master cylinder, the apportioning valves, and finally the road wheel brakes themselves. Modern cars have brakes on all four wheels, operated by a hydraulic system.

HEAT TRANSFER

Heat transfer affects the performance, emissions and durability of the engine as well as the design, packaging, material choice and fatigue life of vehicle components. This course covers the broad range of heat transfer considerations that arise during the design and development of the engine and the vehicle with a primary focus on computational models and experimental validation covering the flow of heat from its origin in the engine cylinders and its transfer via multiple paths through engine components. Specifically, the course will cover heat transfer design considerations related to the following: engine cooling and lubrication systems as well as bay-to-bay breathing; exhaust system and after-treatment components; tail pipe gas temperatures, as well as thermal interactions between the engine and its exhaust system with the components in the vehicle under-hood and under-body; turbochargers; passenger cabin HVAC system,

including windshield de-icing; battery cooling; heat exchangers and challenges associated with predicting thermal mechanical fatigue life of components.

MATERIAL SCIENCE

The goals of automobile design – weight reduction, aerodynamic body design, minimal component rust and deterioration – are all tied to overcoming the chemical limitations of using a combustion reaction as a power source. As a result, the evolution of the automobile industry has historically been paced by developments in material science. Engineers are always limited by the resources at their disposal, so advances in plastics, metallurgy and chemical manufacturing have played a significant role in providing car makers with new solutions to their persistent design challenges.

Within materials science lies the path to superior engine, body frame, transmission, brake and exhaust components.

CONTROL SYSTEMS

This study involves the use of sensors and detectors to measure the output performance of the process being controlled; these measurements are used to provide corrective feedback helping to achieve the desired performance. Systems designed to perform without requiring human input are called automatic control systems (such as cruise control for regulating the speed of a car). Today's modern automobiles have a variety of sensors. They are built into their engine to ensure that the owner can identify and prevent possible issues before they result in breakdowns that can result to expensive repairs. These auto mobile engine sensors also ensure that the vehicle is operating at its most efficient.

3.1 INDUSTRIAL CHALLENGES FOR UNIVERSITY UPTAKE

- Many organizations and industries are under-staffed. So they use the student extensively such that they do not have the time to do what the program aspect of them.
- The organization should note that it is their responsibility to provide safety wares and other consumable to the student. I provided this materials for myself during my program

3.2 SUGGESTION FOR IMPROVEMENT

- The government and higher institutions of learning should plant an eye in every industries and factories. This could be achieved by collecting information from student on training and by paying unannounced visits to company's plants.
- The organization should give incentives to student for job well done or for good manners. This will encourage them to do more and be fully involve in industries activities.

3.3 PERSONAL CHALLENGES

I wasn't allowed to drive cars after repair. So for every car I was given to repair with my boss I could not see the impact of the maintenance made. And I was not allowed to perform repairs outside, I was restricted to the workshop. With the way I was also treated at times wasn't nice by the workshop punishing me for not learning so fast or helping a friend concerning what he/she should concerning a repair

CHAPTER 4

4.0 CONCLUSION

The in cooperation of SIWES program in the engineering syllabus is a brilliant idea because it offers me the opportunity to expose myself to practical work and experience the use of theoretical knowledge gained in the class room. I was actually exposed to computer diagnoses of a wide range of automobile brands. I was involved in so many repairs maintenance and parts replacement in different car brands. I became familiar with the use of modern tools and equipment as well as there working principle. The program for me became an eye opener to life as a working class individual, human relationship and work environment. In overall, I learn how to look at automobile and used my experience to detect fault and proffer solution. This is an attribute that is new born and I have taken the responsibility to build it up, thanks to SIWES.

4.1 RECOMMENDATIONS

In the cause of this program, I made some observation that I will like to bring to the notice of the Student, Engineers, Industries, higher institution of leaning and the general public.

- Students should the SIWES program as a huge opportunity to acquire practical knowledge on their respective fields. It offers the working experience that will be required by most organizations and industries in the cause of employment. The SIWES program therefore should not be seen as a burden.
- The student should not set out for organizations and industries that has good rumination at the expanse of knowledge and value. I would want to discourage the student from pursuing money instead of knowledge. Many student keep turning down offers from organization and industries that has no payment plan for industrial base student while there industrial training period was slipping away.
- The government should stand up to their responsibilities and see to it that Nigeria is industrialized. They should encourage the formation of industries and give guides to small industries already setup and not pull them down with ungodly tax.
- The higher institution of leaning should do well be giving the student attachment letters on time so as to enable search for placement before the training period commences.
- The higher institution of leaning should also monitor the activities of the students during the training period to make sure they participate fully in the exercise. Students of today only take exercise that has direct impact on their GP serious.

- The industries should also not that the students are not part of their work force. Many organizations and industries instead of training the student use them for laborious task that are not even related to their course of study.
- The government should see to it that they establish standard organization that will monitor the activities and practices of the public and private industries. The private industries have the tendency of ungodly exploitation

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