

MOTOR CAR

MAINTENANCE

1156

S. M. Ahmed Zahdi

(جملہ حقوق بحق ناشر محفوظ ہیں)

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|---|---------------|
| اول | ایڈیشن |
| اول | اشاعت |
| 500 | تعداد و اشاعت |
| روپے | قیمت |
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| کامن ویلتھ آف لرننگ | تعاون |
| ناصرہ عقیل | تصاویر |
| سمکت نیازی | رابطہ کار |

حرف آغاز

علامہ اقبال اوپن یونیورسٹی کی بیس سالہ تقریبات کے سلسلے میں ہم یونیورسٹی کے کلیہ تعلیم عامہ کی طرف سے مفاد عامہ کے مختلف موضوعات پر آٹھ مختصر کتابوں کا سیٹ قارئین کی خدمت میں پیش کر رہے ہیں۔ کتابوں کے موضوعات ہیں:-

- | | |
|--------------------|-----------------------------------|
| 1- بچے کی نگہداشت | 5- بہبود آبادی |
| 2- غذا اور غذائیت | 6- موٹر کار کی دیکھ بھال اور مرمت |
| 3- کمپیوٹر سے ملنے | 7- مرغبانی |
| 4- انگریزی بول چال | 8- سبزیاں اگانیں |

انگریزی بول چال اور موٹر کار کی دیکھ بھال اور مرمت کے علاوہ تمام کورسز اردو میں پیش کئے جا رہے ہیں۔ مقصد یہ ہے کہ ہماری بات سادہ زبان میں اور آسان وسیلے سے عوام تک پہنچ جائے۔

ہمارے اس منصوبے کا آغاز 1988ء کے شروع میں ہوا تھا جب مندرجہ بالا موضوعات سمیت کل پندرہ کورسز کی قومی پریس میں اشاعت کا اہتمام کیا گیا تھا۔ کم و بیش تین برس تک روزنامہ 'مشرق'، روزنامہ 'امروز'، روزنامہ 'پاکستان ٹائمز' ہفت روزہ اخبار خواتین اور ہفت روزہ حرمت میں ہمارے یہ کورسز قسط وار شائع ہوتے رہے۔ یونیورسٹی کے اپنے تدریسی اسٹاف نے یہ کورسز تیار کئے تھے اور اس زمانے میں یونیورسٹی کے ادارہ توسیع و خصوصی منصوبہ جات نے پروجیکٹ رابطہ کار کا کردار ادا کرتے ہوئے ان کورسز کی اشاعت کا اہتمام کیا تھا۔

ہم انتہائی خوشی کے ساتھ یہ عرض کرتے ہیں کہ قارئین نے فراخ دلی سے ہمارے ان کورسز کو پذیرائی بخشی، ہماری کوششوں کو 'سزا'، ہمیں اچھے مشورے دیئے ہمیں یہ مفید سلسلہ جاری رکھنے کو کہا اور اصرار کیا کہ ہم انہیں کتابی شکل میں شائع کر دیں۔ اس سے ہمارے حوصلے کو بڑھاوا ملا۔

اب دولت مشترکہ کے ذیلی ادارے کامن ویلتھ آف لرننگ (Common wealth of learning) کے مالی تعاون سے ہم ان آٹھ کورسز کو کتابی صورت دینے کے قابل ہوئے ہیں جس کے لیے ہم اس عالمی ادارے کے شکرگزار ہیں۔

تیزی سے بدلتی ہوئی اس دنیا میں آٹھ دس برسوں میں بہت کچھ تبدیل ہو چکا ہے۔ کمپیوٹر ٹیکنالوجی میں حیرت انگیز

انقلاب آفریں اور تیز رفتار تبدیلیاں رونما ہو رہی ہیں۔ لہذا ان کتابوں کو وقت کے تقاضوں کے مطابق تیار کرنا ضروری تھا۔ ہم نے تمام کورسز کو نظر ثانی کر کے انہیں ضروری ترمیم و اصلاح کے ساتھ شائع کیا ہے۔

ان چھوٹی چھوٹی کتابوں کی اشاعت کو ہم کوئی ایسا بڑا کارنامہ نہیں سمجھتے۔ البتہ ہمیں خوشی ہے کہ ہم نے عمدہ حاضر کے بعض اہم ترین موضوعات پر عام لوگوں کی زبان میں بات کر کے اور ابلاغ کے آسان وسیلے برت کر ایک اچھی روایت کا آغاز کیا ہے۔ ہمیں اعتماد ہے کہ ہم سے کہیں بہتر کام کرنے والے لوگ آگے آئیں گے اور اس اچھی روایت کو فروغ دیں گے۔ ہم سمجھتے ہیں کہ اگر ہمیں وقار کے ساتھ اکیسویں صدی میں داخل ہونا ہے تو علم و آگہی کو کتب خانوں کے شیلفوں اور مراعات یافتہ لوگوں کے مطالعے کے کمروں سے نکال کر عوام میں منتقل کرنا ہوگا۔ مجھے یہ کہتے ہوئے کس قدر فخر محسوس ہوتا ہے کہ ہمارے اس کام سے حکومت کے سوشل ایکشن پروگرام کو آگے بڑھانے میں بھی مدد ملے گی۔

ہمارے اس کام میں بہت سے لوگوں کا اشتراک عمل شامل ہے۔ سب سے پہلے تو مجھے کورسز کے مصنفین مسز شگفتہ ابرار، ڈاکٹر قدسیہ رفعت، ڈاکٹر ارشد محمود، مس فرزانہ عرسانی، سید اولیس حیدر، سید احمد زیدی، ڈاکٹر فضل محمد اور ڈاکٹر سید عطاء اللہ شیرازی کا شکریہ ادا کرنا ہے کہ انہوں نے ہماری گزارش پر بڑی مختصر مدت میں کورسز پر نظر ثانی اور ترمیم و اصلاح کا کام مکمل کر دیا۔ کورسز کی رابطہ کار مس تمکنت نیازی نے جس محنت اور لگن کے ساتھ اس کام کو تکمیل تک پہنچایا اس کیلئے بے اختیار داد دینے کو جی چاہتا ہے۔ جناب اعجاز احمد اور مسز ناصرہ عقیل کو آٹھوں کورس کی تصاویر تیار کرنے کے لیے شب و روز محنت کرنا پڑی جس کے لیے میں ان کی بے حد ممنون ہوں۔ میں ڈاکٹر ایم صدیق خان شبلی اور جناب حامد علی ہاشمی کیلئے بھی سپاس گزار ہوں کہ انہوں نے ان کورسز کی تدوین کر کے انہیں قابل اشاعت بنایا۔ آخر میں مجھے رئیس دانش گاہ پروفیسر جاوید اقبال سید کا بطور خاص شکریہ ادا کرنا ہے کہ ان کی سرپرستی کے بغیر اس کام کی تکمیل ممکن نہ تھی۔

پروفیسر رضیہ عباس
ڈائریکٹر کلیہ تعلیم عامہ

MOTOR CAR MAINTENANCE

PREFACE

Why is the Motor Car Maintenance Important ?

A motor car which does not receive proper care and attention will not operate efficiently even if it is fairly new. Only by routine inspection, servicing and the correction of faults as soon as they develop, can a motor car be properly maintained and made to give service for which it was designed. Motor Car is very expensive to afford and to maintain, specially for middle class persons in this country. Therefore it is always a desire for such persons to keep repair expenses at a minimum.

This booklet in simple language has been written for such persons, who own a car and are interested to read about a best way of their car mechanism and to identify common problems such as Engine refuses to start, Overheats, misses at all speed, Consumes oil excessively, banging in silencer, Improper working of clutch, difficulty in shifting gears, poor brakes application, wobbling of wheels and uneven wear of tyres. The last 6th chapter is reserved, specially for servicing tips - "WHAT TO DO TO KEEP THE MOTOR CAR IN A GOOD RUNNING CONDITION".

During writing the car problems, its causes and rectification, some elementary information has been given about relevant systems and parts of the engine. The purpose of including such information is felt necessary which will be helpful to identify the parts of the engine and rectify the simple faults. After reading all the six chapters, the reader will be able to identify the common problems, their possible causes and rectify simple faults.

S.M. Ahmed Zaidi

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 After every 6000 km service.
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 Precautions
 Checking battery condition and electrolyte level.
 Battery precautions.
 Emergency measures.
 Check the battery for corroded or loose connections.

Chapter No. 1

When Engine does not start

Engine Refuse to start

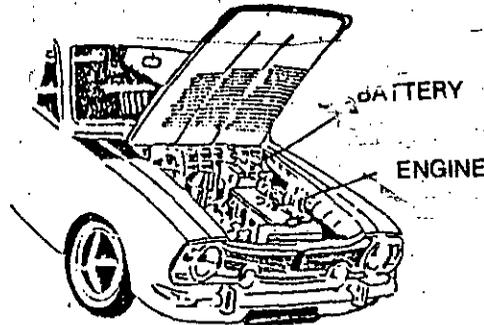
If your motor car on any day does not start at all, when you are sure the last day you have driven perfectly all right.

What will you do?

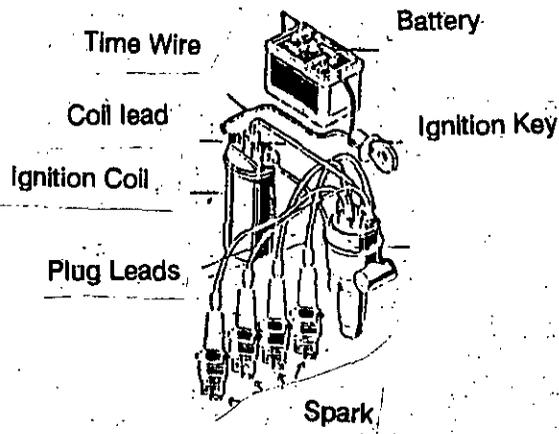
It is necessary to know a little about some of the parts and their systems in order to locate the fault easily.

1. Location of the parts

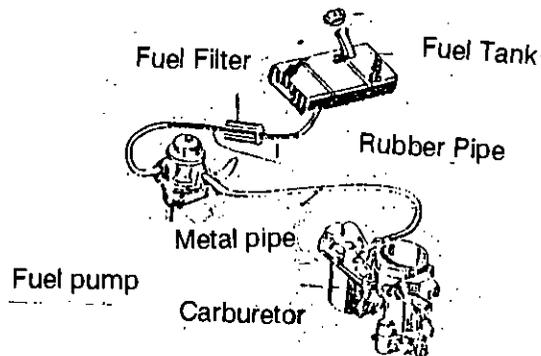
1.1 First open the bonnet. You will see under the bonnet, the engine and the battery, separately fixed in one corner.



1.2 You will see many other parts also attached with the engine. Let us select some of the parts, such as distributor, coil and spark plugs first. They are connected with leads (thick wires) and thin wires to the battery. These parts work according to a system which is known as IGNITION SYSTEM.



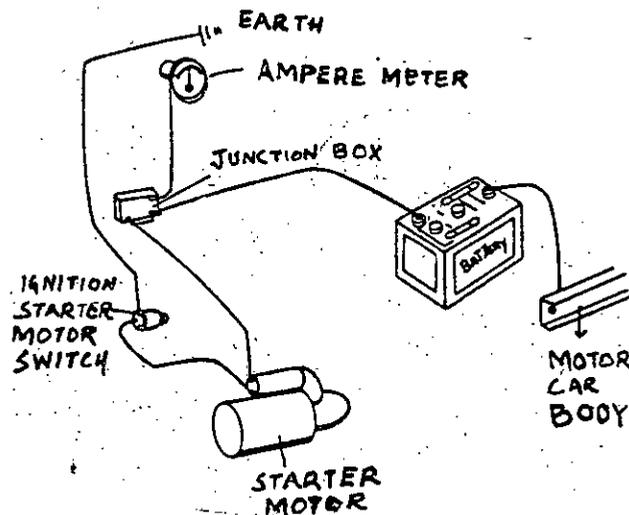
1.3 The other important parts which will you see with the engine, are the carburetor, fuel filter and fuel pump. You will notice they are connected with two different types of pipes. The pipe from the tank is a metal pipe which is connected with a flexible rubber pipe. Fuel filter is fixed to cut the rubber pipe in between two ends. All these parts work under a system which is known as fuel or carbonation system.



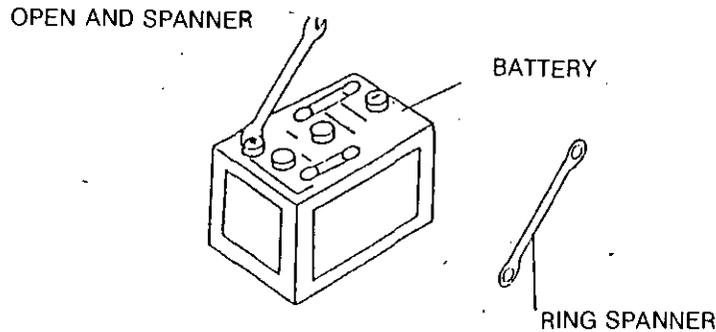
2. Fault finding in the starting system.

When engine refuses to start, you will have to watch carefully whether the starting motor is working and turning the engine or not.

If starting motor does not work at all you must be able to differentiate that there is a fault in STARTING SYSTEM which comprises the starting motor, the battery, key and ampere meter.



2.1 Check the Battery terminals for loose connection

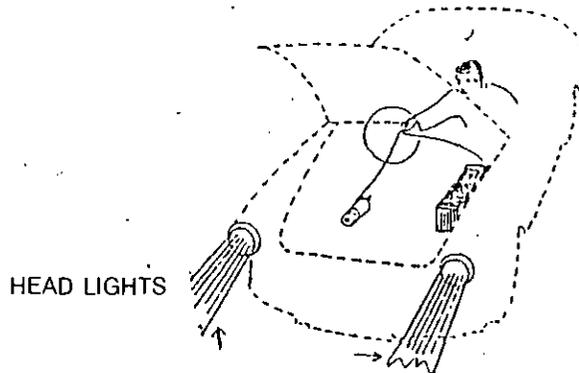


check the battery terminals with correct size open or ring spanner (whatever type is available) for loose connections. Tighten them properly.

2.2 Check the battery condition

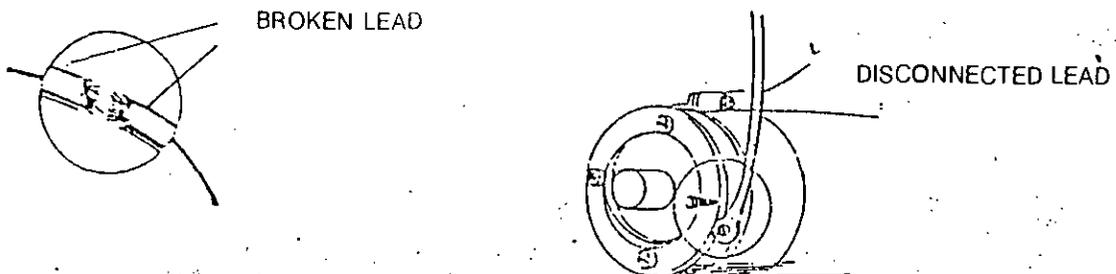
After tightening the battery terminal connections if starting motor still does not work, check the full beam lights by putting the switch on, to know the condition of the battery. Full brightness of the lights shows the good condition of the battery.

Full brightness of the lights shows the good condition of the battery.



2.3 Check the Broken/Dis-connected leads

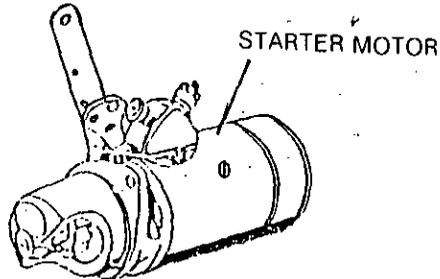
The next possibility could be a broken or dis-connected lead in the starting system.



Check very well the broken lead or disconnected lead with the starting motor by visual inspection.

2.4 Fault in starting motor

If lead is connected firmly with starting motor, and there is no sign of broken lead, the last possibility could be faulty starting motor.

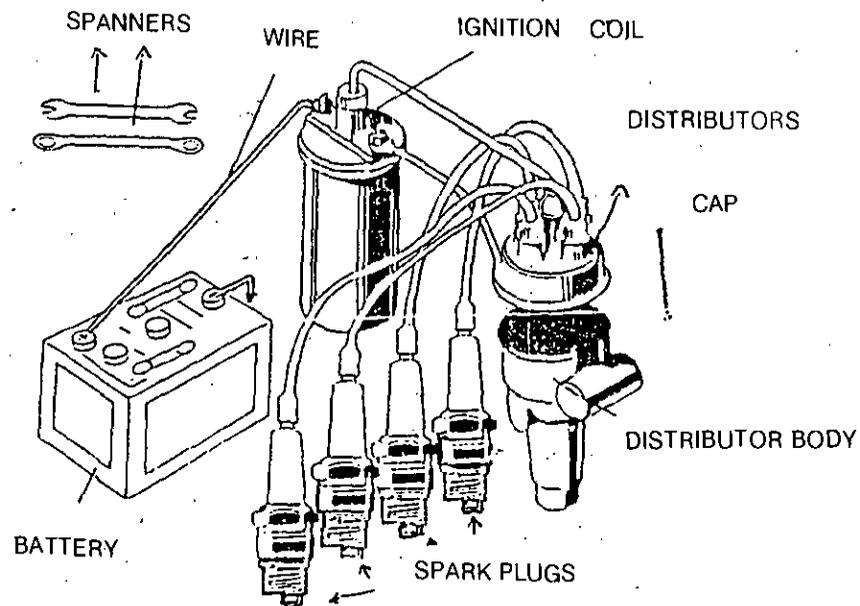


It will be difficult for you to check inside the starting motor. Therefore, it is advised to get it checked by the auto-electrician. In such condition when the starting motor is bad, the motor car engine can be started by pushing it and safely could be driven to the auto electricians shop.

3. Fault Finding

In case the starting motor is working, but engine does not start, you must start checking the following parts as mentioned below:

3.1 Check the Ignition Lead's and coil's connections



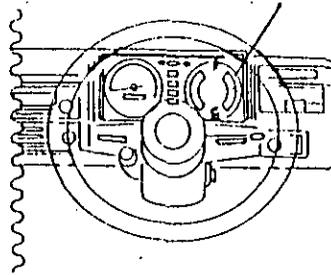
Check all the leads and wires connections with correct size of spanner Carefully. Any one of the leads or wires may not be firmly connected. When you are sure that all the leads and wires are perfectly connected, but the engine still does not start. You are advised to check the fuel system.

3.2 Check the petrol in the tank

The quantity of petrol can be checked by Fuel gauge fixed at the instrument panel (dash board).

If the gauge is faulty and it shows empty tank, then follow the other simplest method by putting the small rubber pipe in the tank. Any portion of the pipe wet with petrol, will show the presence of petrol inside the tank.

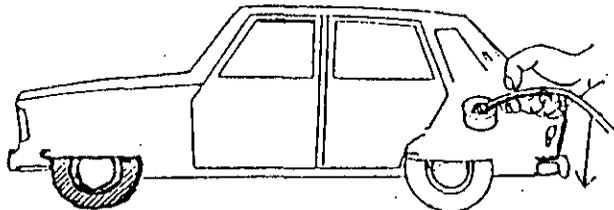
FUEL GAUGE



3.3 When you are sure the presence of petrol inside the tank and still engine does not start, there could be a possibility of carburettor flooding. This is caused by pressing many times of accelerator pedal during starting the engine. This condition can be checked by visual inspection of the carburettor body.

When you see the carburettor body wet, you must wait a while to get the petrol dry and try again to start the engine.

There could be some other faults also like faulty ignition coil or contact breaker points on the Electrical side and blocked fuel filter, faulty petrol pump, or dirty carburettor on the mechanical side. It would be difficult for you to check any of these parts. Therefore, it is suggested to get rectify the faults by your mechanic.



RUBBER PIPE

CHAPTER NO. 2

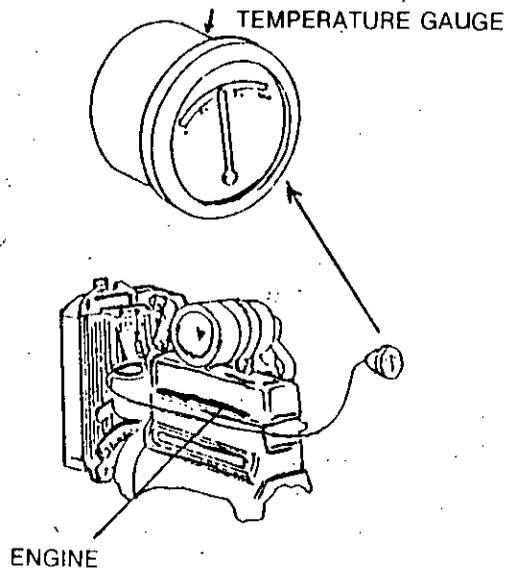
Faults in Engine Cooling System.

ENGINE OVER HEATS:

When a motor car's engine heats up unusually in hot weather, does it mean the over heating of the engine is due to hot weather?

The answer is no. Weather is not the only cause of over heating; but there are some other mechanical causes of over heating which develop inside the engine. Technically, heat above normal operating temperature, provided it is not the maximum showing on the temperature gauge, is not harmful for the engine parts. This is the reason, in winter, it is advised to run the engine idle for at least five minutes to attain the normal operating temperature before driving the motor car on the road.

1. WHAT IS NORMAL OPERATING TEMPERATURE?



Normal operating temperature of the engine shown on the temperature gauge fixed at instrument panel (dash board) is the temperature of water in the cooling system. The range of normal operating temperature is between 70°C to 80°C .

Overheating of the engine can be caused by either some defects in the cooling system, Lubrication system or in both systems.

Before knowing the causes of overheating, it would be necessary to be familiar with the cooling and lubrication systems.

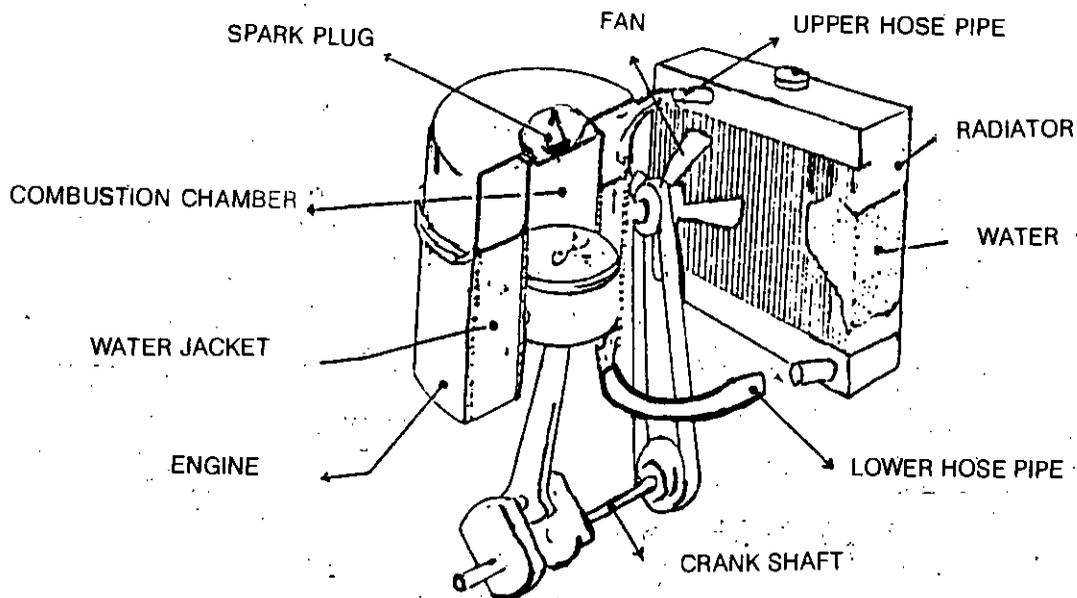
2. PURPOSE OF THE COOLING SYSTEM

The purpose of the cooling system is to keep the engine at its most efficient operating temperature at all engine speeds and under all driving conditions.

Two general types of cooling systems are used.

- i. Air Cooling system.
- ii. Water cooling system.

Motor cars using water cooling system are most popular in Pakistan. This system comprises of the following



FUNCTIONS OF THE PARTS

i. RADIATOR:

It is a cooling chamber through which the water heated by the engine, passes, so that the temperature of the water can be controlled.

ii. WATER PUMP:

It is driven by the fan-belt. It draws cool water from the radiator and supplies to the water jackets where the water is hot.

iii. FAN

It is fitted between the engine and the radiator which helps to cool the water by drawing in air through the radiator.

iv. RUBBER HOSES

Two hoses are used with the radiator. Cool water flows out through the lower hose and hot water enters through the upper hose.

v. WATER JACKETS:

The passage of water around cylinder head and cylinder block.

vi. THERMOSTAT:

It is an accessory fitted in the water system of a motor car which operates on temperature changes.

3. PURPOSE OF LUBRICATION SYSTEM

The purpose of lubricating system is to remove heat from engine parts by acting as a cooling agent and lubricate moving parts to minimize wear and power loss from friction. This system comprises the following essential parts:

i. SUMP

It contains the oil supply.

ii. GAUZE STRAINER

Oil passes through it, before entering the oil pump.

iii. OIL PUMP

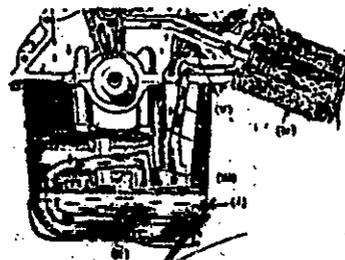
It pumps the oil into the system.

iv. OIL FILTER

It cleans the oil from abrasive metallic particles.

v. OIL GALLERY

These are channels, through which oil with pressure flows to the bearings, cylinders etc.



4. FAULT FINDING IN THE COOLING SYSTEM

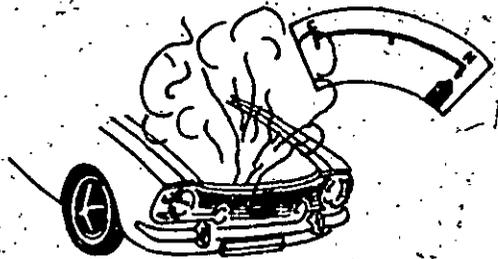
When you notice the needle suddenly showing maximum temperature on the gauge fitted at instrument panel, what will you do?

4.1 CHECK THE FAN BELT

Open the bonnet and check the fan-belt. The main cause of sudden shooting up the temperature on the gauge is due to the broken fan-belt which may be dropped down somewhere during driving on the road. In such condition, you must wait till the engine is cooled down and replace the fan belt.

If you do not have the spare fan belt in the motor car, then do not drive a long way without fan belt. This can damage the engine seriously.

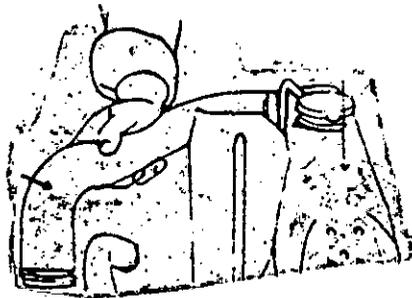
CAUTION: NEVER OPEN THE RADIATOR CAP WHEN THE ENGINE IS HOT



4.2 INSPECTION OF HOSES

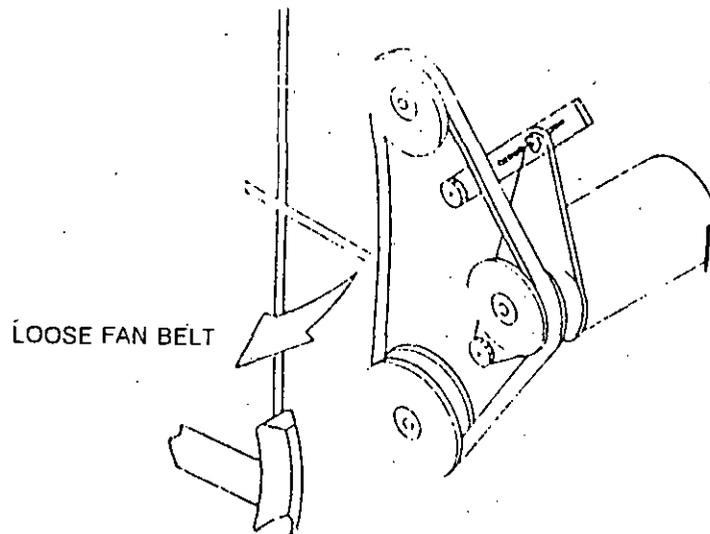
Visually check both the hoses, lower and upper for sign of deterioration.

Squeeze the hose to check its condition. A hose should not be cracked, hard and brittle, nor should it be soft and swollen.



If you notice any of the above defect, you must stop the leakage of water through the hose by putting the piece of cloth around the damaged hose. Replace it immediately when you buy a new one.

4.3 CHECK TENSION OF THE FAN BELT



The proper tension of the fan belt is very important. If it is loose, the water pump will not work efficiently. The tension can be adjusted by loosening the dynamo mounting and adjusting brackets. The bolt should be tightened after the adjustment is completed.

4.4 CHECK THE WATER IN THE RADIATOR

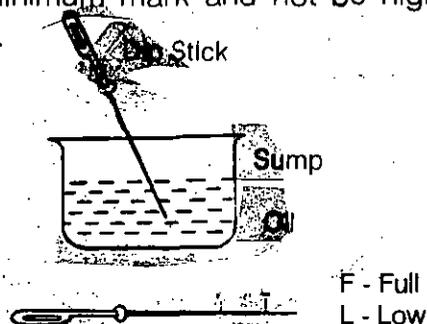
When the engine is hot, do not open the radiator cap. Let the engine be cool down. Check visually the leakage of water through Radiators' body. If the leakage is visible, check the level of water in the radiator to be sure about the loss of water.

Since radiator is very important part of cooling system, therefore get it repaired by the radiators' specialist as soon as possible.

5. FAULT FINDING IN THE LUBRICATION SYSTEM

5.1 CHECK THE LEVEL OF ENGINE OIL

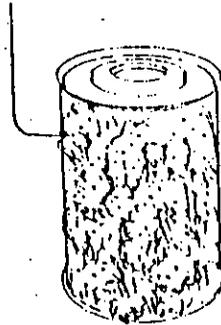
The level of engine oil is measured with dipstick in the sump. It should not be lower than the minimum mark and not be higher than the maximum mark on the dip stick.



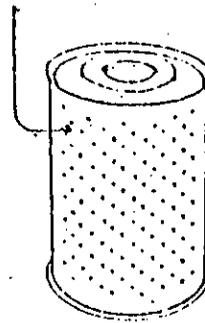
If you see the level lower than minimum mark, add more oil immediately to bring it between the maximum and minimum marks.

5.2 CHECK THE INTERVAL OF OIL FILTER REPLACEMENT

DIRTY OIL FILTER ELEMENT



NEW OIL FILTER ELEMENT

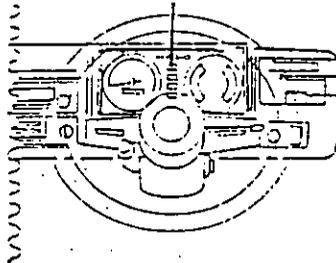


The oil filter should be changed after every 3000 km. (Kilometer) running of the motor car. Clogged filter can seriously damage the engine's parts.

Change the filter and the oil if the engine has already completed 3000 km running.

5.3 CHECK THE OIL PRESSURE LIGHT

OIL PRESSURE LIGHT



There is a warning light for oil pressure on the instrument panel. When the ignition switch is on, it gives light. As soon as the engine is started and its speed is accelerated, it should go out.

If it remained lighted during driving, you must stop the engine and check the level of engine oil by dip stick. In case the level is O.K. but still light does not go, you must get it checked by the mechanic.

MOTOR CAR MAINTENANCE

CHAPTER NO. 3

Fault Finding in the Ignition and carburetion system.

ENGINE RUNS ROUGHLY (BADLY)

The main cause of engine's running rough is due to missing in the engine.

1. WHAT IS ENGINE MISSING?

Smooth running of the engine is only possible when all the spark plugs in multi-cylinder engine are working efficiently and correct mixture of petrol and air is being supplied by the carburetor to the cylinders. In four cylinder engine, there will be four spark plugs. Similarly in six cylinder engine, there will be six spark plugs, one spark plug for each cylinder.

If any one or more plugs are not working efficiently or the carburetor is not functioning properly, the engine will not run smoothly. It means that generally missing can occur in (i) Ignition system.

(ii) Fuel system. For such un-smooth running, we use the term "Engine is missing" or simply "ENGINE MISSING" Smooth running depends on the good engine tune-up job.

2. WHAT IS ENGINE TUNE-UP

Tune-up can be described as the periodic procedure of inspection, testing and adjusting of an engine's parts and replacing any worn parts to restore the engine to its best performance.

A thorough inspection, checking and adjustment or replacement is done in tune-up job on the engine in the following sections.

1. Ignition system
2. Fuel system.

In general, the under mentioned works are important to be done.

1. Checking and adjustment of the valve clearance
2. Inspection and checking of the adjustment of fan belt.
3. Inspection of the water pump for leakage
4. Cleaning and flushing of the radiator and hose pipes.

3. ABNORMALITIES IN THE ENGINE DUE TO MISSING

You will experience the following abnormalities in the engine due to missing:

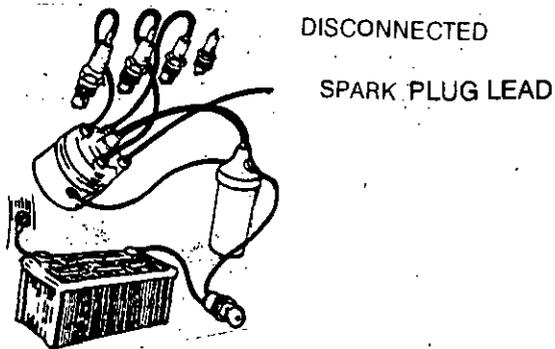
1. The pulling power of the motor car will be less and you will have to press the accelerator more than normally to move the motor car from stationary position in 1st gear.
2. The consumption of petrol will be more than a good tune-up engine of a motor car.
3. The engine running noise will increase.
4. The running will be rough. You will notice too much vibrations in the motor car body when the engine is running and motor car is in stationary position, (idle running).

4. FAULT FINDING FOR THE MISSING IN THE IGNITION SYSTEM

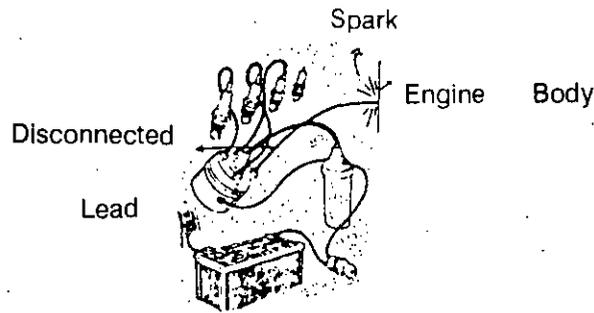
The missing in the ignition system can be found by

- A. Checking the condition of spark plugs
- B. Checking the condition for the leads and distributor cap.

4.1 Steps for checking the condition of the spark plugs.



1. Start the engine
2. Disconnect one spark plug lead to locate the missing in that particular cylinder (dis - connecting the lead, prevents the spark plug from firing).
3. Observe the engine speed or rythem, if there is by change in the engine speed or rythem, it shows the spark plug of that particular cylinder is in good condition. but if there is NO CHANGE in engine speed or rythem, it means the spark plug is defective.
4. Replace the spark plug and check for smooth running of the engine.
5. Check all the spark plugs for each cylinder in a similar manner.

4.2 Steps for checking the condition of the leads and distributor cap

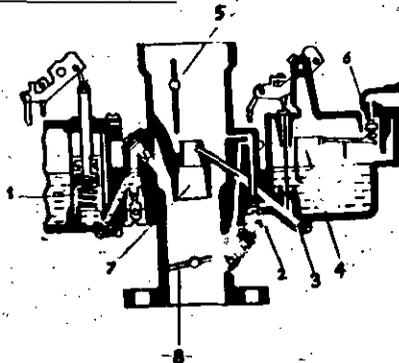
1. Start the engine
2. Remove the spark plug lead from the plug of one cylinder.
3. Hold the spark plug lead clip close to the engine block while the engine is running.

If no spark occurs, there is probably a high voltage leak due to

- i a bad lead
- ii a cracked distributor cap
- iii a burned distributor cap

If a good spark occurs, it means the lead and distributor cap is perfectly all right. Replace a new spark plug in that cylinder.

4. Check all the leads for each spark plug in a similar manner.
5. Re-connect the lead and see whether the cylinder still misses. If it does, the cause of the trouble is probably defective engine parts, such as valves or rings. For such jobs, you must consult a good motor mechanic.

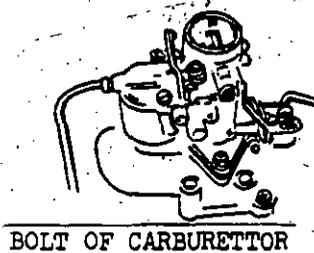
5. FAULT FINDING FOR THE MISSING IN THE FUEL SYSTEM5.1 Check the defects in the carburetor

If the carburetor is not working properly, the engine will not produce full power. In this condition, the motor car does not move when the accelerator is pressed normally. It requires more fuel to attain a required speed and take more time to reach that speed level. A technical term used to describe such condition of the engine is "ENGINE LACKS POWER".

The engine's lack of power may be caused by

1. Improper strength of mixture
2. Faulty accelerator pump (1)
3. Defective metering jet (4)
4. Defective throttle (8)

5.2 Check the defects in the Fuel System



There could be some other causes of engine lack of power other than carburettor itself such as.

1. Faulty fuel pump
2. Clogged fuel filter
3. Clogged fuel lines
4. Air leaks at the carburetor or manifold joints.

All the above mentioned faults effects the strength of mixture which results in reduction of engine power.

5.3 Correction of Faults

The easiest thing to do is to remove the fuel filter and clean it with petrol. Replace it and tight the bolts of the carburetor flange with the correct size of spanner.

If you do not have previous experience of opening the fuel pump, do not try to open it. When you will go to your mechanic for major tune-up, it is his job to check the fuel pump as well.

5.4 What is correct strength of mixture

The correct strength of mixture of air to petrol is 15 to 1 (15:1) respectively. It means the correct mixture will have one kg of petrol which needs 15 kg of air by weight to burn it.

For example, if the strength of mixture is 13:1 or less, the mixture is rich. But if the strength is 17:1 or more, the mixture is poor or lean.

Since the major causes of this type of defects are in the carburetor, it is advised to get the carburetor serviced from an experienced mechanic.

6. BACK FIRING AND ITS CAUSES

This is a common fault which is noticeable when you hear banging in the silencer during driving the motor car. It is necessary to be familiar with the back firing before you know its causes.



What is back firing?

Back firing is the name which is usually applied to explosion taking place in the silencer when unburned mixture escapes through the exhaust valve.

6.1 Causes of Back firing

1. Faulty exhaust valve clearance
2. Defective distributor cap
3. Defective spark plug leads
4. Wrong type of spark plugs.

CHAPTER NO. 4

When does Engine need overhaulingEXCESSIVE OIL CONSUMPTION

1. What are the possible ways of excessive oil consumption in the engine?

Oil is being consumed excessively in the engine by the following three possible ways.

- i. Burning inside the combustion chambers
- ii. External leakage
- iii. Escaping out of the engine through crankcase ventilation system.

- 1.1 Checking for the burning of oil inside the combustion chamber

Before knowing the reasons of excessive oil consumption by burning inside the combustion chamber, you must know the condition of the engine.

If the engine is in sound mechanical condition, the first possibility of oil burning in the combustion chambers can be ruled out. Technically speaking, any new motor car which has not yet completed 50,000 km, should not consume oil excessively. For such new motor car, if there is complaint of excessive oil consumption, check the second or third possibilities mentioned above.

Since, consumption of oil by burning is a major defect in the engine, therefore it is necessary to know a little about the engine and related important parts.

1. WHAT IS ENGINE?

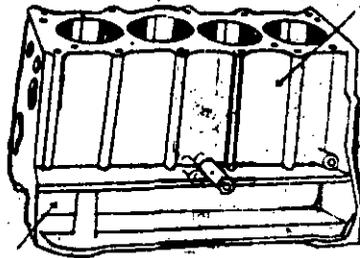
Engine consists essentially of the following important parts:

- a. Cylinder block with crank case
- b. Pistons with rings
- c. Crank shaft with flywheel.
- d. Cylinder head with valves and combustion chambers.

When the above four important parts are combined together, we can give one name to this combination i.e. THE ENGINE

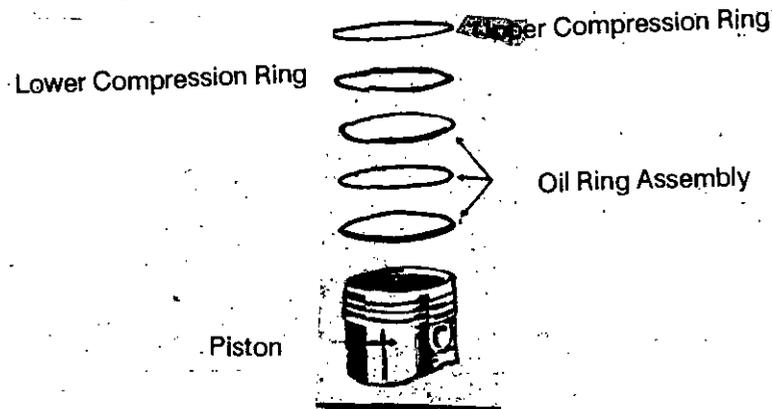
2. FUNCTIONS OF THE ENGINE PARTS

a. Cylinder block and crank - case



The cylinder block and crank - case form the main body of the engine. The other parts are assembled in and on the cylinder block to form the complete engine. The cylinder block provides the smooth, cylindrical bores which guide the motion of the pistons. The crank - case is that part of the engine which supports the crank - shaft and cam shaft and acts a support for the oil pump, starting motor and many other engine parts.

b. Piston with rings



It is a cylindrically metal part which moves up and down inside a cylinder. It carries the power which is produced inside the combustion chamber to the crank shaft. It has two types of rings.

- i. Compression rings
- ii. Oil Control rings.

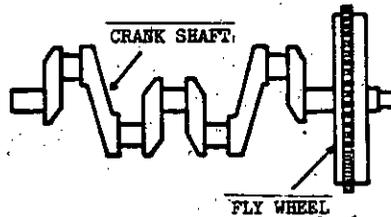
i. Compression Rings

The work of compression rings is to ensure the compressed mixture of air and fuel should not leak into the crank - case.

ii. Oil Control Rings

It stops the excessive oil which is used to lubricate the cylinder walls to pass into the combustion chamber.

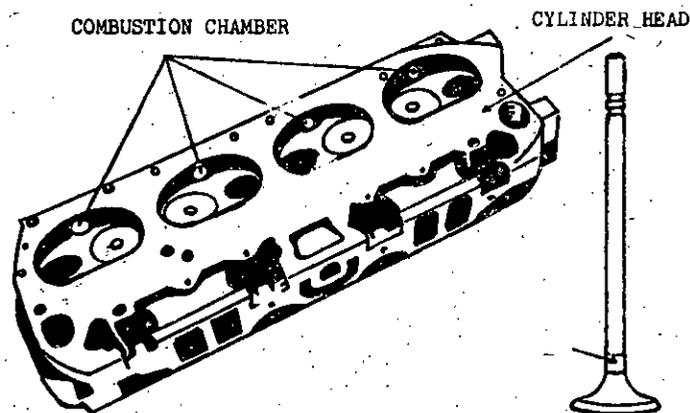
c. Crank - shafts and Flywheel



It converts up and down motion of pistons into rotary motion. Up and down motion is produced due to burning of air and fuel mixture in the combustion chamber.

Flywheel collects the rotary motion from crank shaft and transfer it to the wheels through gear box and differential.

d. Cylinder Head, with valves and combustion chambers.



It is the top portion of the cylinder assembly which is bolted to the top of the engine block. In modern motor - cars, cylinder head consists of

i. Valves and ii. Combustion chambers.

i. VALVES

Inlet valve allows the mixture of air and fuel to enter the combustion chamber and exhaust valve allows the exhaust gases to exit from the combustion chamber of each cylinder.

ii. Combustion chamber

The space provided in the cylinder head in which combustion of the air fuel mixture takes place is called combustion chamber.

3. REQUIREMENTS OF A GOOD ENGINE

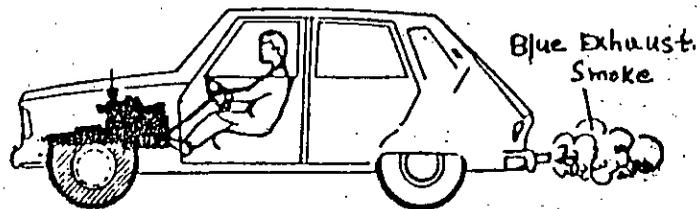
The first requirement of a good (mechanically sound) engine is that the excessive oil should not pass into the combustion chamber through the cylinder walls and the valve guides. Oil rings control this condition. Secondly, the air fuel mixture should not pass into the crank - case and this condition is controlled by the compression rings. Thirdly, there should be no knocking (mechanical noise produced inside the engine). If any one of these conditions happens, the engine is defective and it needs overhauling.

4. WHAT ARE THE SIGNS OF OIL BURNING INSIDE THE COMBUSTION CHAMBER?

Let us look at the external signs by which you can determine, whether or not the oil is burning inside the combustions chambers. If any of the following signs are present, the engine will need overhauling.

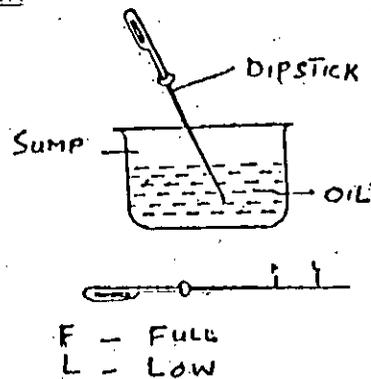
Some of the common external signs are as follow:

a. BLUE EXHAUST SMOKE



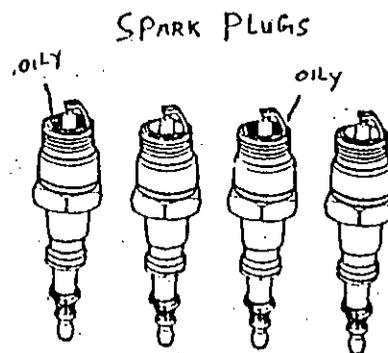
If the exhaust smoke (burned gas) colour is blue, it is the sing of oil burning in the combustion chamber.

b. Daily oil Consumption



The consumption of oil of a good engine on daily basis is so little that it is hardly noticeable. However if the daily checking of oil shows consumption it means the oil is burning inside the combustion chamber of the engine.

c. Oily Spark Plugs



Open all the spark plugs one by one and inspect every plug carefully for any sign of oil. If you see oil in a black muddy condition in any one or more plugs, it confirms that the internal engine parts such as, cylinders and pistons are worn out and the engine needs overhauling.

5. WHAT IS ENGINE OVERHAULING?

Overhauling is the process of checking and replacing of many internal worn out parts to improve the engine performance It can be divided into two types.

- a. Minor engine over hauling
- b. Major engine overhauling.

a. MINOR ENGINE OVER-HAULING

In minor engine over hauling, the following parts are to be replaced when it is confirmed that oil is burning inside the combustion chamber.

1. Piston ring sets (compression and oil rings)
2. Engine head gasket.
3. Oil filter
4. Spark plugs
5. Contact breaker points
6. Sump and tappet cover gaskets
7. Any other gaskets and rubber seals which are damaged.

b. MAJOR ENGINE OVERHAULING

In major engine overhauling, the following parts are to be replaced and specialist works such as cylinder boring and crank - shaft grinding are to be done.

1. Pistons with rings
2. Connecting rod end bushes
3. Main and big end bearings
4. Valves with guides
5. Engine overhauling complete gasket kit
6. Oil pump
7. Oil filter
8. Spark plugs.
9. Contact breaker points
10. Timing chain
11. Cylinder block reboring or replacement of sleeves
12. Crank - shaft grinding.

The cost of major (general) overhauling is around Rs. 8,000/-. The amount will vary according to the type of motor car, kind of garage and intensity of wear in the engine. The period of overhauling can be reduced by regular maintenance of the motor car. A well-maintained motor car engine can run upto 2,00,000 km. with out any repair work done inside the engine.

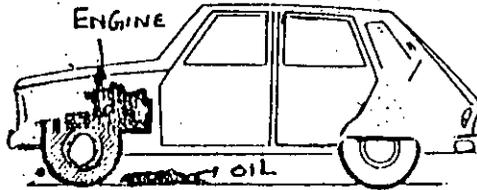
c. HOW WILL YOU KNOW WETHER THE ENGINE NEEDS MINOR OVER HAULING OR MAJOR OVER HAULING

If the engine is not very old, for example it has not completed 50,000 km running and there are no unusual mechanical noises inside the engine, for such cases minor overhauling in needed.

On the other hand, if the engine is consuming excessive oil by burning inside the combustion chamber, losing power and making unusual mechanical noises inside the engine, such engine will need major (general) overhauling

1.2 CHECKING FOR THE EXTERNAL LEAKAGE

1. Check the leakage under the motor car



External leakage can be easily checked by visual inspection.

- a. Check the drops of oil on the floor under the motor car in the morning.
- b. If the floor is not cemented, put the sheet of paper under the car in the evening when you park it for overnight.
- c. If the floor or sheet of paper is dirty with oil, check the engine oil with dip stick and note any lower level comparing it with the previous evening.

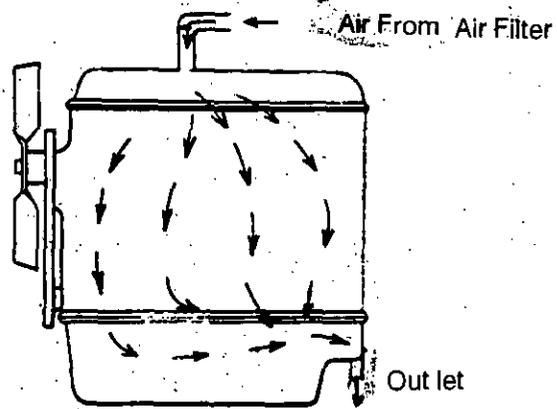
2. How to stop the leakage

Inspect the engine from under neath, any part wet with oil should thoroughly be checked. If it is from joints of the sump or drain plug or oil indicator switch, the nuts or bolts should be tighten very well. If it is from the engine which is the crank case seal, you must consult the mechanic for this job.

1.3 CONSUMPTION OF ENGINE OIL THROUGH CRANK CASE VENTILATION SYSTEM

High speed of a motor car on long distance is also the cause of excessive oil consumption. Oil temperature increases as the engine speed increases. Therefore oil becomes thin due to high temperature and it is consumed by two ways in the engine.

- a. Oil will pass to combustion chamber where it will be burned with the mixture of air and fuel, since oil control rings will not work efficiently due to thin oil.
- b. Oil will be changed into vapours form due to high temperature and these vapours will escape through outlet pipe of the crank - case ventilation system.

1. WHAT IS CRANK CASE VENTILATION SYSTEM

When the engine is in operation and the oil in the crankcase is hot, the unburned fuel and water in the crank case are in vapour form.

The fresh air entering the engine from tappet cover, circulates through the crank case to draw off these vapours with the oil fumes before they contaminates the oil.

There is almost no consumption of oil for a sound mechanical engine of a car when it is driven in the town, but the oil consumption is increased when the same motor car is driven on long distance with high speed.

CHAPTER NO. 5

IMPROPER WORKING OF CLUTCH, GEAR BOX, BRAKES AND STEERING SYSTEM1. What is the most common problem of improper clutch working?

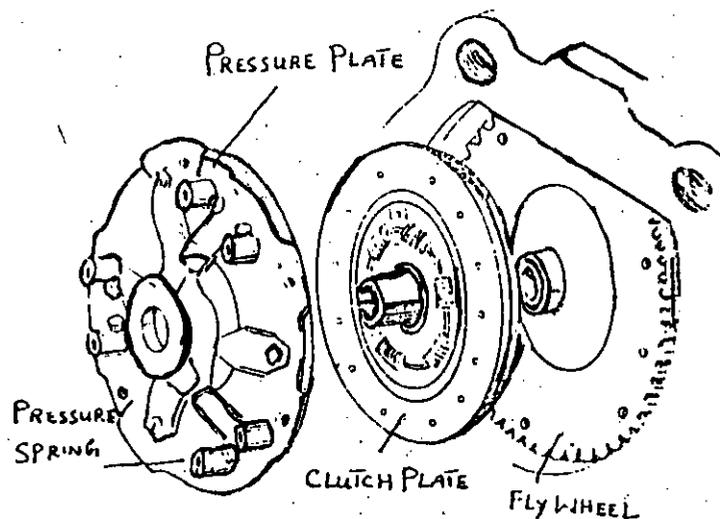
Clutch slip is the most common problem which a driver usually comes across in clutch operation.

Clutch slip is indicated when the accelerator is depressed and the engine speed increases, but speed of the car does not increase according to the depressing of the accelerator.

Note: Before taking up the causes and correction of the above most common problem i.e. clutch slip, let us study a little about the clutch function, its main parts, their work and clutch free play.

2. What is the function of clutch?

The clutch disconnects the engine from the transmission (gear box, propeller shaft and back axle). It enables the drive to be taken up smoothly and make gear changing easy

MAIN PARTS OF CLUTCH AND THEIR WORK2.1 Flywheel:

This part is fixed with engine crank shaft which rotates with it and transfer rotating power to the gear box through clutch friction disc.

2.2. Friction Disc (Clutch plate)

It is attached with the gear box shaft which can move to and fro on it receives the power from flywheel and transfers it to the gear box input shaft.

2.3. Pressure Plate

This is a heavy plate with smooth face. It is attached with the friction disc when the clutch pedal is free.

2.4. Pressure Springs:

The main work of these springs are to keep pressed the friction disc with spring pressure between flywheel and pressure plate.

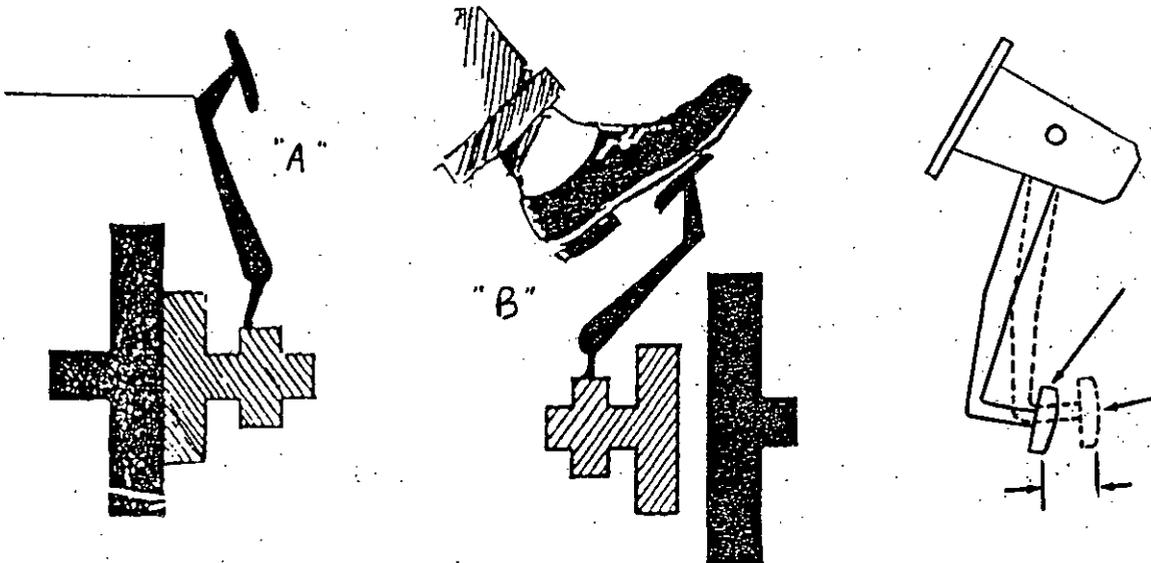
2.5. Clutch Cover:

It is a cover which protects the friction disc from water and dust.

2.6. Release Bearing

The bearing that can be moved in to the release levers of the pressure plate by clutch pedal action, so as to cause dis - connection between the engine and flywheel.

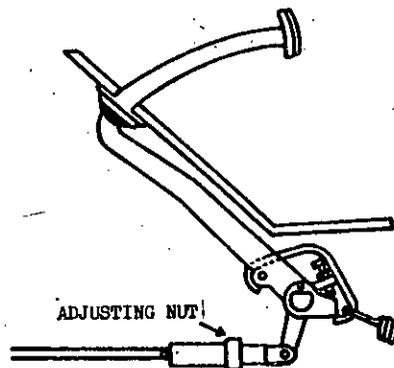
- Note: i When pedal position is free, Clutch friction disc is pressed between flywheel and pressure plate.
- ii When the pedal is depressed by foot pressure clutch friction disc becomes free. (No engagement between flywheel and friction disc).

3. CLUTCH PEDAL FREE PLAY

The movement of the pedal from "A" to "B" in the above figure is known as clutch pedal free play. When the pedal is depressed from the position of "A" the clutch dis engagement would not be affected at all till the foot pressure reaches "B". This small distance should be about 25 mm (millimeter).

Note: As wear occurs, the pressure plate moves nearer to the flywheel and consequently the amount of pedal free movement diminished. If it is not re-adjusted, a stage will be reached when the pressure plate is unable to engage fully, and slipping of the Clutch will occur.

3.1 CLUTCH PEDAL FREE PLAY ADJUSTMENT



Adjust the pedal from the adjusting nut to give 25 mm free play before any resistance is felt on the clutch pedal.

3.2 Causes of Clutch slip:

1. In - sufficient clutch pedal free play
2. Oil on clutch plate.
3. Worn clutch plate lining

3.3 Correction of Faults:

1. Re - adjust clutch pedal free play to make it 25 mm as explained above.
- 2&3 Reline the clutch plate or replace it

Note: Clutch pedal free play is important therefore you must check it yourself or by mechanic when you have any complaint of improper clutch working. Remember, it should not be more than 25 mm. If there is indication of oil on the clutch plate lining or worn lining, clutch plate has to be taken out from the assembly for inspection. To take out the clutch plate, gear box has to be dismantle first. Replacement of clutch will take at least four hours when an experienced mechanic will do this job. If the oil found on the clutch or

worn lining, clutch plate has to be replaced in both conditions. But in case of oil on lining, the cause of oil reaching to the plate has to be found out. Probably crank case rubber seal may need replacement.

4. PROBLEMS IN GEAR BOX

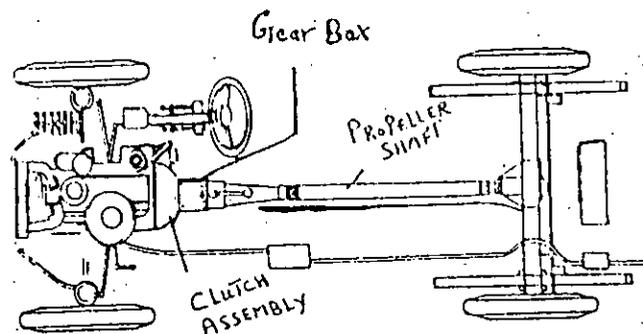
- a. Slipping out of Gear.
- b. Difficulty in selecting gears.

Note : Before knowing the causes and correction of faults, let us study about the purpose of gear box, location and its parts.

4.1 WHAT IS THE PURPOSE OF THE GEAR BOX?

Gear box allows the engine to run at different relative speeds to the road wheels, so that it may maintain its power.

4.2 Location



Gear box is located between clutch assembly and propeller shaft as show above.

4.3 PARTS OF THE GEAR BOX

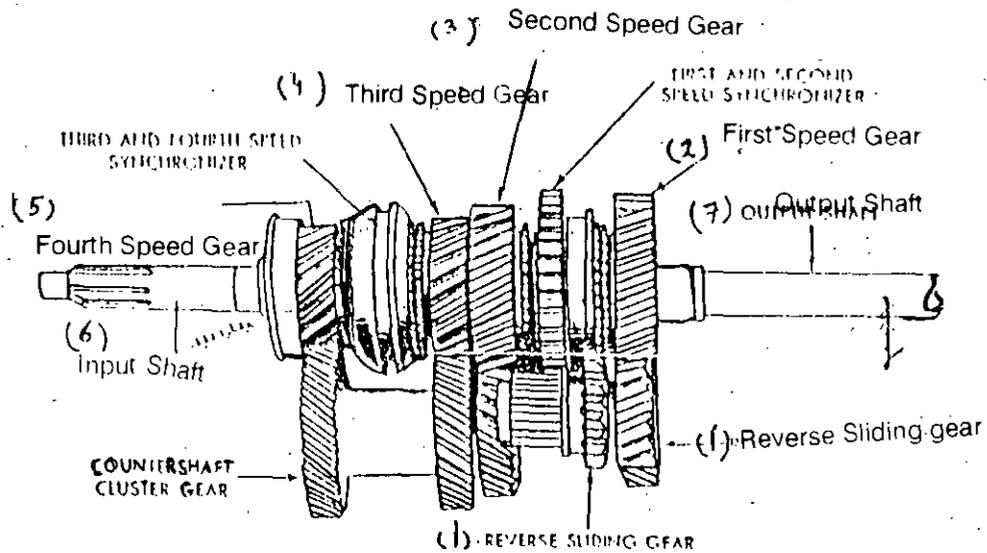


FIG 1. Reverse sliding gear.

FIG 2. First Speed Gear.

FIG 3. Second Speed Gear.

FIG 4. Third Speed Gear.

FIG 5. Fourth Speed Gear.

FIG 6. Input shaft

FIG 7. Output shaft

4.4. PROBLEMS IN THE GEAR BOX

- a. Slipping out of Gear.
- b. Difficulty in selecting gears.

a. Slipping out of Gear

1. Causes:
 - i. Worn Gears
 - ii. Selector shaft spring too weak
 - iii. Worn bearings
2. Correction:
 - i. Replace gears as necessary
 - ii. Fit new springs
 - iii. Replace new bearings

b. DIFFICULTY IN SELECTING GEARS

1. Causes:
 - i. Excessive clutch pedal free play.
 - ii. Gear shift linkage out of adjustment.
 - iii. Pressure plate defective
2. Correction
 - i. Adjust 25 mm pedal free play.
 - ii. adjust linkage
 - iii. Replace pressure plate.

NOTE: Gear box repairs is a complicated and expensive job. Therefore, select specialist garage which have experienced mechanic and special tools to work on gear box or replace a good used complete gear box. Sometime, replacement is much cheaper than repairs.

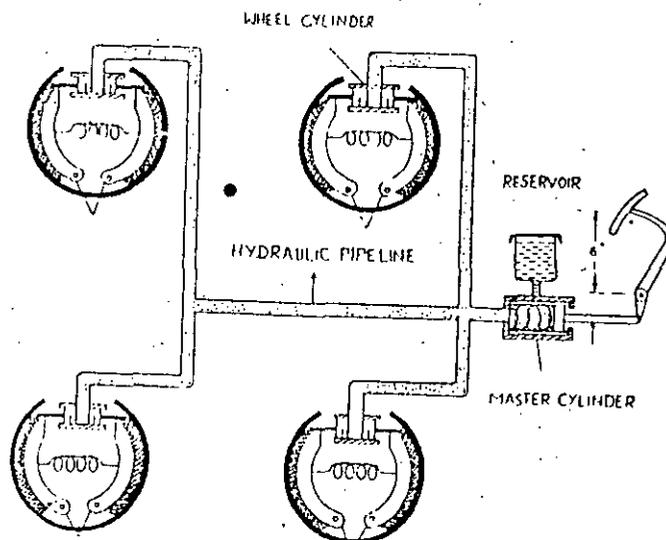
5. PROBLEMS IN BRAKING SYSTEM

1. Pedal goes to floor board with little or no resistance.
2. Sponge pedal action
3. Poor braking with excessive pressure required on pedal.

Let us see how a good (efficient) braking should be as compared to the poor braking before describing the causes and correction of faults of the above mentioned common problems in braking system. It is also necessary to know about the hydraulic drum braking system.

5.1 What Features should an efficient braking system possess?

The brakes should operate smoothly, stopping the motor car in a reasonable distance and retain their adjustments for long period.

5.2 Parts of the Hydraulic Drum Braking system.

- a. MASTER CYLINDER Master cylinder is the most important component of the hydraulic system. When foot pedal is depressed, it transfers the fluid with pressure to the four wheel cylinders.
- b. Reservoir: Fluid is always reserved in this container. It should always full with good quality brake oil.
- c. Wheel Cylinders: They are four in number and attached on a plate which is fixed with the axle. They are connected with pipe lines.
- d. Hydraulic Pipe Line: These pipelines connect all four wheels with master cylinder.
- e. Brake Shoes: They are also fixed with the plate one end of the shoe is attached with the piston of wheel cylinder.
- f. Brake Drum: Brake drum is mounted on the brake shoes. Each wheel has two shoes, Wheel is fixed with bolts to the drum. When the brakes are applied, the shoes expand and touches the inner side of the drum. When drum stops to rotate, the road wheel also stops to rotate.

6.1 **PROBLEM: PEDAL GOES TO FLOOR BOARD WITH LITTLE OR NO RESISTANCE:**

1. Causes :
 - i. Not enough brake fluid in reservoir
 - ii. Oil leak, in system.
 - iii. Worn linings.
2. Correction:
 - i. Check the level of fluid in the reservoir and refill it to within a quarter of an inch of top.
 - ii. Check for leaks of oil at master cylinder and wheel cylinders and replace rubber cups and parts in faulty cylinders. Check leaks from pipes also.
 - iii. Adjust brakes if linings are not too badly worn. Replace linings if badly worn.

6.2 **PROBLEM: SPONGY PEDAL ACTION**

1. Causes:
 - i. Brake shoes not adjusted properly
 - ii. Air in system.
2. Correction:
 - i. Adjust brakes to correct clearance.
 - ii. Take out air by bleeding hydraulic system.

6.3 **PROBLEM: POOR BRAKING WITH EXCESSIVE PRESSURE REQUIRED ON PEDAL**

1. Causes: Oil on lining and drum causing slipping

2. Correction: Check for leakage of oil at wheel cylinder and axles. Repair as necessary clean lining and drums.

NOTE: Brake adjustment and bleeding is important in hydraulic drum brake system. The indication of mis-adjustment is that the pedal travels more towards floor board of the car without actions. The pedal travels for brake application will be less showing the brake lining worn out. If the pedal is spongy (like sponge, pressing with less force), bleeding is necessary. Bleeding is the process by which air in the system is taken out.

7. PROBLEMS IN STEERING SYSTEM

1. Wobbling of front wheels.
2. Uneven wear of front tyres.

7.1 PROBLEM: WOBBLING OF FRONT WHEELS

- Causes
- i. One of the wheels or both are out of balance.
 - ii. Tyres pressure uneven.
 - iii. Worn or loose front wheel bearings.
2. 1. Balance both the wheels on balancing machine for statically and dynamically.
 2. Inflate both front tyres with equal recommended air pressure.
 3. Adjust or replace bearings.

7.2 PROBLEM: UNEVEN WEAR OF FRONT TYRES

1. Causes:
 - i. Uneven tyre pressure
 - ii. Improper alignment
2. Correction:
 - i. Inflate both the front tyres with equal air pressure.
 - ii. Proper alignment with the correct equipment should be done by experienced operator.

NOTE: Improper alignment can cause hard steering, pulling to one side, wandering of wheels and rapid tyre wear. Similarly wobbling can also cause tyre wear and shaking of steering at a certain speed which sometime becomes dangerous for safe driving.

Therefore, if there is complaint of wheel wobbling (shaking from side to side) and uneven tyre wear, balancing of front wheels and alignment should be get it done earlier by some experienced operator with accurate equipment.

CHAPTER NO. 6

WHAT TO DO TO KEEP THE MOTOR CAR IN A GOOD RUNNING CONDITION.

1. SERVICING TIPS

1.1 Daily Inspection and maintenance

The condition of the motor car changes daily, Therefore, before leaving the house every day, inspection and maintenance of the motor car should be carried out.

The following items should be checked daily. It may take a bit more time when you will carry out checking for the first time, but when you will make a daily routine, it may take hardly fifteen minutes including the time spent on cleaning the exterior body of the motor car.

1.2 Tyres Air pressure

Inspect all the four tyres for low air pressure or any damage . If any one tyre showing less pressure, check it with the air pressure gauge. If it is far below the recommended pressure, inflate it before reaching the office/ shop or replace it with the spare wheel which must have recommended air inside.

2. Engine oil level

The oil level should be inspected by placing the car on a level surface. The oil level should be checked either before starting the engine or at least two or three minutes after stopping the engine by pulling out the dipstick from the engine. Wipe oil off with a clean cloth from the dip stick and insert it into the engine, then remove it again. The correct level of oil on the dipstick should be between the upper and lower limits usually written "F" (Full) and "L" (low).

3. Radiator water

Before sotarting the engine, check the water level in the radiator by opening the cap. If the level is low, pour more water into the Radiator until it reaches the top and refit the cap securely.

Some motor cars have separate water reservoir, a plastic tank in addition to the radiator. Check the water level in the reservoir tank. Pour more water if the level is under low mark by opening the cap. Refit the cap properly after adding the water.

4. Brake Fluid (Oil)

Check the fluid level in the brake fluid reservoir. The fluid level should be above the "MIN" line. It is at or close to the min line, fill up with more brake fluid.

5. Brake Pedal

Check the brake pedal for the distance between the pedal and foot board when the pedal is depressed with a normal force. If the pedal is not hard and touching the floor, do not drive the car in this condition. It needs immediate attention for repair.

6. Clutch Pedal Free Play

Check the clutch pedal free play. It must not be more than 25 mm. If the play is more than recommended, get it re-adjusted by the mechanic at earliest.

7. Indicator lights for charging battery and oil pressure

Check that these lights come on when the ignition switch is turned on and go out after the engine had been started.

8. Temperature Gauge and Speedo meter

Make sure that these gauges and meter functions normally while running the motor car.

9. Horn, Turn Signals and Wipers

Check that the horn, turn signals and wipers are in proper working order.

10. Fuel Gauge:

Check that the gauge functions normally when the ignition key is turned on.

11. Rear Mirror

Check that there is a clear vision from the driving position. If not, readjust it.

12. Fuel in the tank

Make sure that there is enough petrol in the tank to reach your destinations.

13. Cleaning the car body

Clean the car's exterior body all around with a soft piece of soaked cloth. If you are not in hurry, clean all the four wheels also with a soaked sponge.

1.2 Weekly Inspection and maintenance

1. Repeat the daily inspection and maintenance.

2. Wash the whole exterior body with running water to remove dirt and mud from the body with a soft sponge. If the body is too dirty and oily, use a car wash soap which is available from the motor spare parts shops. Prepare a soapy solution in water and clean the body with the solution and sponge. The sponge should be frequently soaked in the

CAUTION:

Never use strong house hold detergents or soaps. They can damage the paint.

3. Clean and wash the tyres and rims with the solution prepared by water and house hold detergent.
4. After washing the motor car body, let it be dried in the air by parking it in shade. Apply car wax and polish with a soft cloth and shine it with a piece of flannel.
5. Clean the interior with a soft brush and mats with the solution of water and house hold detergent.
6. Check the battery terminals for corrosion and electrolyte level of the battery. If terminals are dirty, clean it with warm water and let them dried in the air. After being completely dried, apply grease to protect them from corrosion. The level of electrolyte should be upto the maximum mark on the battery container. If the level is lower in any cell, refill it with distilled water only.
7. Inspect the fan belt tension. If it is loose, adjust it by loosening the dynamo mounting and adjusting brakets. Tighten the bolt after the adjustment of the belt which should have at least 12 mm slackness.
8. Inspect the engine all around when it is off and clean it with a piece of cotton rag.

1.3 MONTHLY INSPECTION AND MAINTENANCE

1. Get the washing, oiling and greasing of the motor car from that commercial service station who do washing with pressurized water under the body as well as exterior all around. They wash mats and interior also. Greasing of the suspension system and oil spray under the body is also included in this service.
2. Drain the radiator water and flush it with fresh water.
3. Wax and polish it as you do weekly.
4. Repeat the daily inspection and maintenance exercise.
5. Check gear box and differential oil (Add oil to level) if necessary.

2. PERIODIC MAINTENANCE SCHEDULE

2.1 After 1000 km (first service for new cars or overhauled engine)

1. Change the following items

- i. Engine oil (30/40 SAE)
- ii. Oil filter
- iii. Gear box and differential oil (for new cars only)

2. Adjust if necessary
 - i. Fan belt tension
 - ii. Engine idle speed.
3. Inspect and correct if necessary
 - i. Ignition timing (By electronic ignition gun)
 - ii. Fuel tank cap. Fuel lines and connection
 - iii. Clutch pedal free play.
 - iv. Brake pedal travel
 - v. Hand brake lever and cable.
 - vi. Brake fluid.
 - vii. Wheel and hub nuts.
 - viii. Steering conditions.
4. Tighten if necessary
 - i. Head and manifold nuts/ bolts
 - ii. Bolts and nuts of an engine and suspension system.

2.2 AFTER EVERY 1500 KM SERVICE

List of the works to be done in this service.

1. Change the engine oil
2. Clean the air filter
3. Clean and adjust if necessary the gap of spark plugs.
4. Check the contact breaker (C.B.) points gap. Adjust if necessary.
5. Lubricate the distributor rotating cam with a few drops of engine oil.
6. Check the battery specific gravity with hydrometer.
7. Top up the battery if necessary with distilled water only.
8. Check the battery terminals and cables for corrosion.
9. Check the fan belt tension.
10. Check the clutch pedal free play.
11. Check the foot brake pedal travel.
12. Check the brake fluid level.

2.3 AFTER EVERY 3000 KM SERVICE

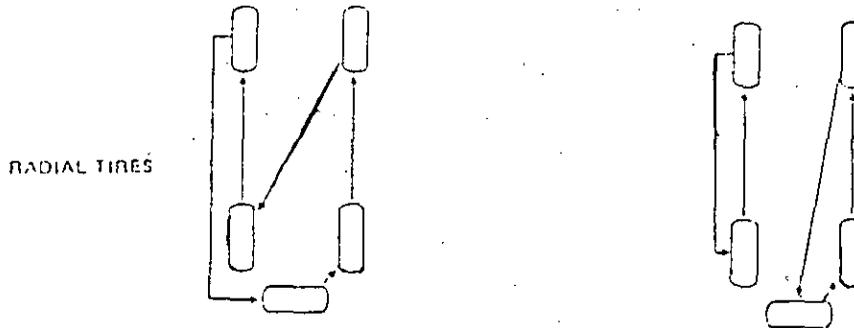
1. Repeat 1500 km service.
2. Change oil filter.

2.4 AFTER EVERY 6000 KM SERVICE

1. Repeat 3000 km Service
2. Change Contact breaker (C.B.) points.
3. Change spark plugs.
4. Inspect gear box and differential oil add if necessary.
5. Adjust brakes if necessary.

2.5 AFTER EVERY 9000 KM SERVICE

1. Repeat 3000 km service.
2. Rotate tyres as illustrated below to avoid unbalanced wear of your tyres and to prolong their life span.



2.6 AFTER EVERY 18000 KM SERVICE

1. Repeat 3000 km service.
2. Inspect and adjust if necessary the valve clearance according to manufacturers recommendation.
3. Replace fuel filter.
4. Inspect and replace if necessary the rubber hoses for cooling system.
5. Inspect and replace if necessary the distributor cap and rotor.
6. Inspect and tighten if necessary the exhaust pipes and silencer mountings.

3. DO IT YOUR - SELF - MAINTENANCE

3.1 Precaution

Utmost care should be taken when working on your motor car to prevent accidental injury. Here are a few precautions that you should be especially careful to observe.

1. When the engine is running, keep hands, clothing, and tools away from the moving fan and engine drive belts (Removing rings, watches and ties is advisable).
2. Right after driving, the engine, Radiator and exhaust manifold will be hot, so be careful not to touch them. Oil and fluid may also be hot.
3. Do not smoke, cause sparks or allow open flames around fuel or battery. The fumes are inflammable.
4. Be extremely cautious when working on the battery. It contains poisonous and corrosive sulphuric acid.
5. Do not get under your motor car with just the body jack supporting it. Always use automotive jack stands or other solid supports.
6. Remember that battery and ignition cables carry high current

of voltages. Be careful of accidentally causing a short circuit.

7. When closing the engine hood, check and see that you have not forgotten any tools, rags, etc.

3.2

Maintenance

Many of the maintenance items are easy to do yourself if you have a little mechanical ability and a few basic automotive tools.

1. List of the basic tools

- i. Spark plug socket wrench.
- ii. Wheel nut wrench.
- iii. Medium size flat screw driver
- iv. Medium size phillips type screw driver.
- v. Electrician plier.
- vi. Open end spanner set (six pieces)
- vii. Ring type spanner set (six pieces).
- viii. Small size adjustable wrench.
- ix. Feeler gauge.
- x. Centre punch.
- xi. Ball pein hammer (350 g.)
- xii. Flat file (200 mm.)
- xiii. Oil filter wrench.

2. Procedure to change the engine oil and filter

1. Warm up the engine for a few minutes and then turn it off. Remove the oil filter cap.
 - a. Park the motor car on a level spot. Warm up the engine since warm oil will drain faster and more thoroughly. Turn the engine off.
 - b. Remove the oil filler cap. This allows air to enter the engine as the oil drains.
 - ii. Remove the drain plug (Located under the sump) and allow the oil to drain fully.
 - a. Place a drain container (tray) under the drain plug.
 - b. Using a ring spanner of the correct size, remove the drain plug and allow the oil to drain fully.

Precautions: The oil may be hot. Do not touch with the finger - Be careful not to burn yourself.

- iii. Remove the old oil filter and install a new one hand-tight. Reinstall the drain plug.
 - a. Using an oil filter wrench, loosen the oil filter. It turns anti-clockwise. Once loose, you may unscrew it, the rest of the way by hand. When removing it, hold up the end so that oil does not spill out.
 - b. With a clean rag, wipe off the mounting surface on the engine so that the new filter will seat well.

NOTE: Make sure that the old gasket has not stuck to the mounting surface. If it has, remove it before installing the new filter.

- c. Smear a little engine oil on the rubber gasket of the new oil filter.
- d. Screw the new filter into the place and tighten it until the gasket contacts the seat. Then give it additional 3/4 turn to seat the filter.
- e. Reinstall the drain plug and its gasket washer. Tighten the plug with the correct size spanner, but do not force it and strip the threads.
- iv. Pour oil through the filler hole on the top of the engine and install the filler cap. Start the engine and check for leaks at the filter or drain plug.
 - a. After pouring the oil, make sure that the filler cap is installed hand tight. You should double check the oil level on the dipstick.
 - b. With the engine running, look carefully for any small leaks around the oil filter or drain plug. Any leak indicates a faulty installation.
 - c. Turn the engine off and wait few minutes. Check the oil level again and add oil if necessary.
3. Drain the radiator water and flush it out with tap water
 - a. Park the motor car on a level ground where the dirty water can drain into a suitable disposal container.
 - b. Remove the radiator cap if it is cooled. Do not remove the cap if the engine is hot.
 - c. Loosen (turn anti-clockwise) the two drain plugs. One from the bottom of the radiator and other from one side of the engine cylinder block. **DO NOT LOOSEN THE DRAIN PLUGS IF THE ENGINE IS HOT.**

- i. CLOSE THE TWO DRAIN PLUGS AND FILL THE COOLING SYSTEM WITH TAP WATER. INSTALL THE RADIATOR CAP.
 - a. Make sure that both drain plugs are securely tightened.
 - b. Pour the tap water into the radiator from the top inlet of the radiator until the water starts dropping from the overflow pipe.
 - c. Start the engine and top up with water if necessary.
 - d. Install the radiator cap and reservoir cap (if you have external plastic container in your motor car) and double check that the drain plugs are not leaking.

4. CHECKING BATTERY CONDITION AND ELECTROLYTE LEVEL:

- i. Battery precautions:

The battery produces an inflammable and explosive hydrogen gas. Therefore,

- a. Do not cause a spark from the battery with tools.
 - b. Do not smoke or light a match near the battery.
- ii. The electrolyte contains poisonous and corrosive sulphuric acid, therefore,
 - a. Avoid contact with eyes, skin or clothes
 - b. Keep children away from the battery

- iii. EMERGENCY MEASURES:

- a. If electrolyte gets in your eyes, flush your eyes with clean water for atleast 15 minutes and get immediate medical attention.
- b. If electrolyte gets on your skin, thoroughly wash the contact area. If you feel a pain or burn, get medical attention immediately.
- c. If electrolyte gets on your clothes, there is a possibility of its soaking through to your skin, so immediately take off the exposed clothing and follow the procedure above, if necessary.

- iv. CHECK THE BATTERY FOR CORRODED OR LOOSE CONNECTIONS.
 - a. If the battery is corroded, wash off with a solutions of warm water and baking soda. Take care that no solution gets into the battery. Coat the outside of the terminals with grease to prevent further corrosion.
 - b. If the connections are loose, tight the clamp bolts, but do not oversight. Be careful not to be cause a short circuit with tools.
5. Always use the recommended spark plugs or equivalent when replacing clean and adjust the gap yourself.
6. Checking, correction / cleaning and replacement of the following items can be done by yourself.
 - i. Cleaning the air filter.
 - ii. Cleaning or replacemer t of fuel filter.
 - iii. Checking of C.B. points gap by feeler gauge.
 - iv. Checking and replacing fuses.

