THE MOTOR CAR
How it works

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She hesitated, coughed gently and lingered awhile. Then, engine held high, she glided past the crowd like a queen. She was a 1902 Oldsmobile and had reason to be proud. For she was at the head of an impressive line-up of cars on Barakhamba Road, New Delhi.

"Full steam ahead", ordered the Chief of the Naval Staff as he flagged off the Vintage Car Rally.

It was February 13, 1983. Eighty long years since this grand old lady was born. And what an applause she received.

From then on there was no stopping. The waves rolled on—Austins, Buicks, Cadillacs, Fords—you name it and it was there.

This rally has inspired Indians to preserve some of the earliest cars that landed on our soil. Perhaps, one of these days you too can participate in such a rally (the only condition is that you should own a car more than fifty years old) and come chugging down the streets of Delhi or Calcutta, jingling the bells of your nineteenth century Rolls Royce.

That, incidentally, is what actually happened. The first Rolls that came to India
had bells, not horns! In those days bullock carts were commonly used in India. A string of bells, hung loosely round the bullocks’ neck, helped clear the way as the cart moved along.

When Rolls Royce first sent out their cars to India they assumed that people would respond better to bells than horns. Thus the bells.

India was one of the first few countries to import cars. In fact, in the years that followed she proved her excellent taste by importing some fine specimens, especially from Britain.

Soon after the precedent was set by the United States, India imported her first car in 1897. This was followed in 1898 by three Oldsmobiles brought in by Jamshetji Tata and two other prominent Parsees of Bombay.

How did it all start?

Not very long ago, if one said “let’s go” it meant walking to wherever you had to go or perhaps getting around by horse if the weather permitted.

When the wheel was discovered man achieved one of his strongest desires—to travel faster than his legs could carry him.

Strangely enough no one knows who invented the wheel. But, with its evolution and with the taming of animals, horse-drawn chariots and coaches, bullock-carts and wagons became the most efficient means of transport.

The world became a more familiar place as villages, towns and cities grew. The paths along which men travelled developed into roads.

And then came the Industrial Revolution, which triggered the most rapid developments in transport. From one kilometre an hour man began to travel at
five, ten, twenty and forty kilometres an hour. The only difference was that, instead of horses or bullocks driving the wheel, machines were used.

The 'horseless' carriage or the motor car was a dream come true. It was the first time that man could speed along in a self-propelled vehicle.

Engineers designed certain motor vehicles driven by steam. But these were slow, very noisy and belched sparks and smoke as they moved along.

The first steam road vehicle was a gun-tractor built by the French engineer, N.J. Cugnot, in 1769.

By 1840 steam coaches were no longer visible on the roads. Electric cars began to take their place. In contrast to the steam vehicles they were clean and noiseless. But electric cars run on batteries and batteries can drive a car only for short distances. They need to be re-charged. So the electric car too had a short life and cars driven by petrol nosed their way into the limelight.

If you have any German friends, you could say that your friends’ great, great, grandfathers made the first motor car. For, it was in 1885 that two German engineers, working independently, produced vehicles which can be termed the forerunners of today’s cars. Gottlieb Daimler and Karl Benz did not exactly invent the motor car, but they brought together a number of
inventions and improved on them.

Most of you must have heard of internal combustion. It is power derived from the explosion of a mixture of fuel and air in a cylinder. Based on this principle Daimler devised the first high-speed, single-cylinder, petrol-driven engine. He tried this out first on a three-wheeled tricycle and later, in 1886, on a four-wheeled car. Karl Benz, also working on the same principle, built his first car in 1885. Three years later Benz became the first man to offer cars for sale to the public.

There was only one problem—what to call this newfangled machine? Early automakers toyed with several names—‘automation’, ‘oleo locomotive’, ‘motorig’, ‘motor-fly’ and ‘electrobot’, before finally settling on ‘automobile’—a French word meaning ‘self-movable’.

Cars were now owned by people. But only a handful. The handful that could afford the exorbitant price.

Cheaper by the thousands

It was in 1909, when an American, Henry Ford, mass produced his famous Model-T that cars became cheaper. They were also easier to drive and more reliable.

Thousands of workers fixed the parts to the cars, each group doing only one job. Some tightened the nuts while others did nothing but fit the brakes and so on. All Ford cars looked alike. “You can have any colour you like,” said Ford, “as long as it is black”.

Around this time, in 1911, India possessed more than 100 cars. Of all these the Rolls was perhaps the only one that could survive Indian conditions.
The first Rolls Royce, 'Pearl of India' as it was called, had already entered India in 1908. Designed especially by Cockshoot of Manchester for the Maharajah of Gwalior, it was specially built for tropical conditions. It had a high ceiling and ventilators. It was finished in cream with apple-green stripes edged with gold.

Royalty were among the first to make regular use of the car. The Maharajahs being fond of shikar, Rolls Royce wasted no time in selling them cars specially designed for this purpose. Off came the roof and instead was placed a grass ceiling on four poles to create just the right atmosphere for a shikar. No wonder then, our Princes look back so nostalgically on those days of yore!

The Maharajah of Patiala at one time owned ninety Rolls Royces, while the Maharajah of Bharatpur had twenty-five. And talking of car lovers, there was no one who could match the Nizam of Hyderabad. For, whenever he saw an expensive and beautiful car in his kingdom, the owner was informed that His Exalted Highness would like a ride in the car. The owner, honoured and hardly believing his luck, would rush his car off for the royal drive. The car, of course, was never returned.

Thus the Nizam collected a fleet of three hundred to four hundred cars that were never used. Many years later when the Chief Minister of Hyderabad suggested that he sell his cars, the Nizam turned down the proposal and, instead, spent two and a half lakhs of rupees to get them overhauled.

The craze for cars ended suddenly with the advent of the first World War. Cars and buses carried soldiers and their supplies into battle.
Car designers found they had a lot of time on their hands to make better engines and vehicles. In fact by the end of the war the motor car was ready for another lap ahead.

One of the more famous cars to be produced in Britain at that time was the Austin 7, popularly known as the ‘Baby Austin’—a tiny four-seater that was cheap and reliable.

Many great cars were built in the 1920’s—so much so that car enthusiasts describe that period as the Vintage period.

What goes up must come down. And sure enough, soon after the vintage period came a slump in trade. That was when car manufacturers had to really think hard. ‘How do we make cars that people can buy?’

Of course mass production was the only answer. Exclusive cars like Mercedes Benz, Rolls Royce, Bugatti, Alfa Romeo, and Delage for the rich continued to be manufactured. But, for the masses, cars that give you more mileage had to be thought of.

It was at this time that another baby was born. The Fiat 500. This car was called the ‘Topolino’ or little mouse in Italy. For the enthusiasts there were sports cars.

Today not only are cars mass produced, their spare parts are also mass produced.

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Bugatti Royale, type 41, was the first of six cars that were the world’s biggest. It was over twenty two feet long with a bonnet of over seven feet. It was produced in 1927.
What makes a car tick

We know the people who invented the motor car and those who fell in love with some of these charming beauties. It's time we sat inside a car and took a peek at how it works. You turn the ignition key and zoom off. So simple yet so complex.

Just as you live on food and water, cars live on fuel. To start the car, the driver turns the ignition key sending electricity from the battery to run the little starting motor which gets the engine going. Rrr..... rrr......... rr.........! Fuel dashes the engine through a carburettor.

The job of the carburettor is to mix petrol and air in controlled proportions. To start a cold engine a 'richer' mixture is required. The carburettor can produce this when its 'choke' control is operated. Then, quick as lightning, this mixture is ignited by a spark from a spark plug. Phut, Phut, Phut! There's an explosion. No, not the kind that happens during war time. Just internal combustion within a cylinder. This forces the piston inside the cylinder to go down and turn a crankshaft. All this requires four different actions or 'strokes'.
1. **Intake stroke**—The piston descends with the intake valve open, allowing vapour to fill the cylinder. The intake valve then closes.

2. **Compression stroke**—The piston ascends, compressing the vapour up into the top of the cylinder, called the combustion chamber.

3. **Power stroke**—The spark plug ignites the compressed vapour and causes it to 'explode'. With this the piston goes down again.

4. **Exhaust stroke**—The piston ascends and, with the exhaust valve open, pushes the burnt gases out of the cylinder. The exhaust valve then closes. Now the engine is ready for its first stroke again. The amount of mixture allowed into the combustion chamber is controlled by the accelerator pedal under the driver's foot—the more the mixture the faster the engine runs.

Most cars have four cylinders. Each one fires at a slightly different time, thus allowing the car to run smoothly. The piston is attached by a connecting rod to the crankshaft which changes an up-and-down
movement into a rotary (turning) movement. So, when the piston moves down, the crankshaft moves round. From the crankshaft the turning motion is transmitted to the wheels.

What makes a car move?

We’ve got the engine started. Now how do we get the car moving. This is where the transmission system comes in—the link between the engine and the wheels. The gear box is a part of this system.

A car’s gearbox is a complicated piece of machinery and to master it takes all you’ve got. In fact while learning to drive, practically every driver breaks into a cold sweat at the thought of changing gears. But, unfortunately, all of us are not VIP’s and no pilot-car will clear the road for us. So, tough luck. Gears will have to be changed when you want to go fast or slow as the case may be—when you come to a traffic signal, when a dog crosses the road, when you’re going uphill or downhill.

A car usually has four forward gears plus one for reversing. When you start the car you put it into first gear. Unless you’re a rash driver and start in the second gear!
Gradually you move up to four depending on the speed at which you are travelling.

In many countries automatic gears are being used in cars. No sweat. No tears. You just hold the steering wheel and the car does the rest.

Indian cars, however, are not yet equipped with automatic gears and until then it is "1,2,3,4," for us.

**The power carrier**

The propeller shaft is another part of the transmission. It has a difficult name but a simple job to do. All it does is take the power from the engine to the axle. The axle transfers power to the wheels. Whether the engine is driving a motor car, a bus or a truck, the principle behind transmitting
power from the engine to the wheels remains the same.

The wheels of a car are held up by springs so that they can move up and down over bumps. So must the propellor shaft. For, it is the shaft that has flexible joints at either end and is thus able to deliver power.

When a car goes round a corner, the inner wheels—those that are closest to the corner—travel a shorter distance than the outer ones. Therefore the outer wheels must receive more power. Each wheel has thus to be controlled separately.

The mechanism that feeds the wheels with the right amount of power is called the differential.

The link up

The clutch is a device that gradually separates or joins the engine to the transmission parts.

It has two plates that are linked with the engine and the transmission. When you press the clutch pedal down, you separate the engine and the transmission system.

As the clutch pedal is released and the plates come in contact, the power of the engine begins to feed the wheels.

This must be done gradually in order to make a smooth start. For, when the clutch is released the plates begin to engage. If this is done too fast, the car will lurch forward and you'll end up with a broken nose, if not

'Horse-Power' doesn't apply to horses at all. It describes the power of the engine. The term was coined by James Watt, well-known for his steam engines.

If you could lift a 550-pound (about 250 kg.) weight one foot from the ground in one second, you would have used up one 'horse-power' of mechanical energy.
Bumpity-Bumpity, Bump, Bump, Bump!

The only way to avoid a bumpy ride is to ensure that your car has a sound suspension system. The suspension holds the car body with the aid of leaf and coil springs. It prevents the car from bouncing too much after going over a bump. The shock absorbers are part of the suspension system.

Old cars had wheels like prams. The front and rear axles were joined to the main body by "cart springs". Today, wheels too are demanding freedom. Car manufacturers are trying to make each wheel independent.

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The Clutch System

a broken head! Now you know why learner drivers sometimes turn the poor car into a Kangaroo.
The front wheels of all modern cars have independent suspension. This helps to keep the car level when going over a bump.

Stop

'When in doubt, right foot out'. That is the first thing one is told when learning to drive. It applies to the brakes, of course.

Every car has two braking systems. The main one is worked by a foot pedal. It acts on all four wheels. The other is the hand-brake. It is a mechanical system and acts only on the back wheels. It is normally used for parking or emergencies.

In the main braking system there are brake drums or discs attached to each wheel. Usually the disc brakes are on the front wheels and the drum brakes on the back wheels. The brake linings that actually stop the car are mounted on shoes inside the brake drums. When you push, the shoe fluid is pushed out of a cylinder and pumped along four tubes to each of the wheels, which have expanding cylinders. This forces the shoe against the drum or disc on each wheel and slows it down. This

To meet American safety requirements the British made Ford Fiesta has to withstand a 30 mph (approximately 50 kph) side ways impact by a 4,000-pound (about 1,814 kg.) weight, while about ten cameras record the result.

The Suspension System
1. Shock absorber 2. Coil springs 3. Leaf springs
is done by hydraulic pressure.
Disastrous accidents have taken place when the brakes in a car fail suddenly. The right thing to do when faced with such a situation is to switch off the ignition and put the car into first gear immediately. That may break the gear-box, but will stop the car.

Talking of accidents, one of the world’s greatest car accidents took place in Le Mans, near Paris, in 1955. Le Mans is famous for the 24-hour non-stop motor racing event, the French Grand Prix d’Endurance.

World champion Fangio was competing and new cars with famous drivers were expected to establish speed records.

Entrants included Mercedes’ of West Germany, Italian Ferraris and Maseratis, Gordinis of France, British Jaguars, Aston Martins and so on.

The story goes that Mike Hawthorn in a new D-type Jaguar was seriously challenging Fangio in his silver Mercedes Benz. Both cars were doing well.

Then Mike Hawthorn began to brake in order to pull into his pit on the right so that his co-driver could take over. As he slowed down and pulled over towards his pit, a Mercedes came up from behind to pass at about 180 mph (288 km/h). It swerved and
touched an Austin-Healey. All eyes were on the Mercedes. The earth bank, designed to function as an exterior brake, seemed to have lifted the car into a somersault, so that it soared through the air and fell into the crowd, at a cost of nearly 100 lives. All it took was three seconds.

A 'Grand Prix' is a race over a closed circuit on a special track built for racing. The circuits are usually four to eight kilometres long. All the cars have to complete a certain number of laps and cover between three hundred and four hundred kilometres.

A rally, on the other hand, requires a car to cover thousands of kilometres in just a few days. In India, for instance, we have the Himalayan Rally in which cars are expected to fight out the route over the most desolate stretches of the Himalayan mountains.

**Turn**

When you hop into a car and casually steer the wheel, several movements take place at the same time.

A large movement of the steering wheel has to be changed to a much smaller movement of the road wheels. The gears in the steering box help make this change.

A rod (the drop arm) at the end of the steering box moves. This pushes another rod which is joined to one of the front wheels. The wheel is connected to the other by a link called the track rod. The links between the rods and the wheels are called steering arms.

Cars too go round the corner! When that happens the inner wheels must turn more sharply than the outer ones. The links
between the steering box and the wheels are shaped in such a way that the wheels can turn at different angles. That, surely, would make anyone's head turn!

The power-station

A car has its own power-station—but mercifully this one is not subjected to load shedding! It can have a power-failure all right.

The dynamo is the power house. It will make electricity when it is driven by the engine.

Electricity is needed all over the car. For the lights, horn, wiper, radio, self-starter and, in modern cars, for changing gears,
When a car gets hot

Like you, cars too feel hot sometimes. The combustion in the cylinder produces a lot of heat. If something was not done to cool the car, the engine would stop working.

It is for this reason that the cylinders are surrounded by water jackets. Water is forced through these jackets by a water pump driven by the engine. Heat passes into the water from the cylinders. The water then travels to the radiator. The radiator has little tubes through which the water passes. A fan, driven by the engine, cools the water in them. The cold water is then pumped back into the water jackets to absorb more heat from the engine.

The Electrical System

fighting cigarettes, raising the hood, heating and cooling. It is for this reason that the battery must be kept charged at all times. This is done by the dynamo which continually charges the battery.
A car needs greasing too

A car engine has many metal parts rubbing against one another. These parts must be oiled regularly to prevent them from wearing or sticking together. The lubrication system maintains a constant oil flow to the moving parts in almost the same way as blood is pumped through the body by the heart.

The oil is stored at the bottom of the engine in a trough called the sump. An oil pump forces oil from the sump to the moving parts of the engine. Some parts, such as the main bearings on the crankshaft, receive oil directly. Other parts, such as the cylinder walls, are splashed with oil from other moving parts. The oil comes back through the engine into the sump. There it passes through a filter and goes round the engine again. The filter removes any dirt in the oil.

Several other moving parts also require external lubrication from time to time.

Perhaps the most advanced family car today is Citroen the DS 19, produced by France. The wheels are held up by balloons of gas. This is controlled hydraulically so that the car finds its own level on the road, whatever bumps it may encounter.

The most expensive car to date is the U.S. Presidential 1969 Lincoln Continental Executive delivered in October 1968. It cost $500,000 (now approximately 60 lakhs of rupees).
1. Petrol filler  
2. Leaf spring  
3. Exhaust silencer  
4. Steering wheel  
5. Gear lever  
6. Hand brake  
7. Gearbox  
8. Clutch  
9. Oil filler  
10. Air filter  
11. Carburettor  
12. Fan  
13. Radiator  
14. Bumper  
15. Dynamo  
16. Steering box  
17. Clutch pedal  
18. Accelerator pedal  
19. Brake pedal  
20. Frame  
21. Propeller shaft  
22. Leaf spring  
23. Wheels  
24. Petrol tank  
25. Differential  
26. Axle
On its tyres

The tyres are the only part of the car in contact with the road. This is why they must always be in good condition.

It was John Boyd Dunlop of Britain who produced the first air-filled tyre. Before this wheels were made of solid rubber or iron. Today tyres have inner tubes like bicycle tyres and some are tubeless.

The pressure of air in the tyres needs to be checked constantly. If it is too low or too high, driving can be dangerous. For instance, when you have heavy luggage in the boot, it is advisable to increase the pressure in the back tyres.

We have tried to tell you as simply as possible, how a motor car works. Some of you may want to examine a car more closely after reading this and who knows, if you are curious enough, one day you might design even better cars than what we have today.

A Victorian motorist perhaps best described how a car works when he placed this placard on his car:
"It is an autocar,
Some people call it a motor car,
It is worked by a petroleum motor,
The motor is of four horse power,
It will run sixty miles on one charge of oil.
No, it can't explode, there is no boiler,
It can travel at fourteen miles an hour.
Ten to eleven is its average pace,
It can be started in two minutes,
There are eight ways of stopping it, so it can't run away.
It has to be steered with one hand,
The speed is mainly controlled by the foot,

It can be stopped in ten feet when travelling at full speed.
It carries four gallons of oil and sixteen gallons of water,
The water is to keep the engine cool,
It costs less than three farthings a mile to run......."
This book, one of a series of information books, introduces the child to the motor car. It explains in a simple manner how the car works and traces briefly the history of the automobile.

Others in this series include:

- The Television
- The Telephone
- The Aeroplane
- The Clock
- The Ship
- The Railway Train
- The Computer

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