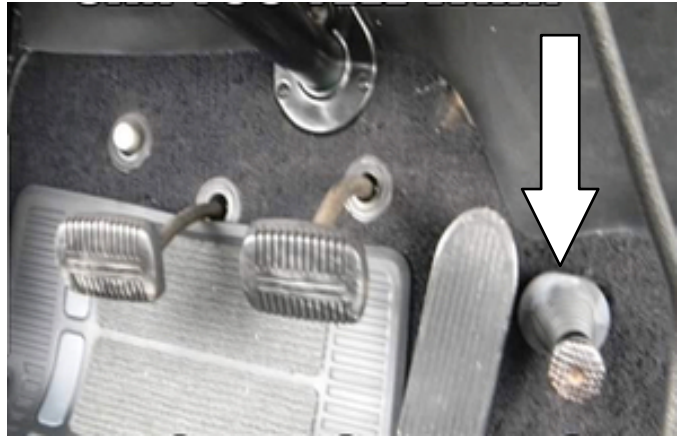


## 1. Understanding What Makes Your Car Go: The Ignition Switch, Starter and Battery

Before you get behind the wheel and actually learn how to drive a car, it's important to have an understanding of how your car works. There are many, many parts to a car and knowing their jobs and how they work together is important. In this course, we'll look first at some of the most important parts of your car along with the jobs they do. Then we'll look at learning how to operate your car on the road. Let's begin with the parts of your car first.

### THE KEY

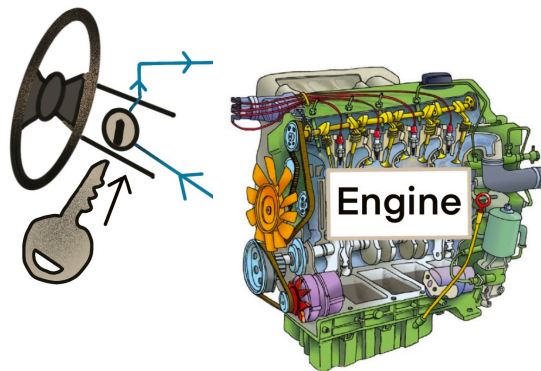
The most logical place to begin understanding how your car works is with the key, often referred to as the ignition key. Historically, cars had no key but only a switch or button designed to allow you to start the car. Because cars have traditionally held great value, it soon became necessary to move from the simple starting switch to a key which would allow you to protect your investment and prevent someone else from simply driving away with it. Originally, the key and switch were separate components (the key on the dash and the switch on the floor). Eventually, the two components merged into one item on the dashboard.



In early cars and trucks, the button which activated the starter motor was found on the floorboard (above). Later, the button migrated to the dashboard (bottom).



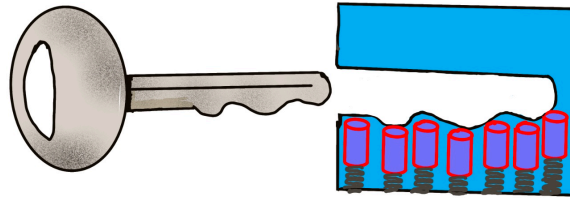
Keys are traditionally made from a piece of metal with an intricate shape cut into one end. This intricate shape matches perfectly with the inner parts of the switch in which it is inserted. This switch is known as the ignition switch as it directly links to the parts of the car which result in the ignition of fuel (gasoline or diesel in most cases).



In modern cars, the ignition switch is found on the steering column. The key is inserted and, when turned, it activates an electrical circuit which starts the car's engine.

Let's turn back to our discussion of the key. As we mentioned, car keys are created for a specific ignition switch and, to be more specific, an inner portion of the ignition switch known as the cylinder. In order for the key to be able to turn and start your car, it must perfectly match the

design of the cylinder. Anything other than a perfect match results in the inability to turn the switch and start your car.



The key, which has a very specific shape, slides into the cylinder and presses onto a set of pins. The pins must be pressed to a specific position which will allow the key to turn.

If your car key gets lost or stolen, you can possibly get a new key made by a locksmith or hardware store. However, some keys are marked in a way that prevents a copy of a key from legally being made. A completely new key and ignition set can be re-installed in your car if necessary, but this can be costly. The ideal habit is to have a second (or even third) set of keys kept in a safe place (*not inside your car*). The best safe place is inside a cabinet or on a key rack inside your house.



Extra sets of keys (both for your car and your house and buildings) are best kept on a key rack inside your house.

Should you accidentally lock your keys in your car, it's not terribly difficult to get your car open should you not have your second set of keys handy. Attempting to open a locked car is tricky and you can inadvertently damage your car if you're not sure what you're doing. The safest and most reliable way to open a locked car door is to call a locksmith. Finding a local locksmith is not difficult with the use of your cell phone. Simply search for "a locksmith near me" and a list of choices should appear.

A locksmith will charge you a basic fee which may depend upon the time of day you need help and the number of miles he or she has to travel in order to assist you. It's usually more expensive if you need help after normal business hours or if it's on a weekend or holiday. The actual work to open your car usually takes only 1-2 minutes. The time required for the locksmith to arrive is usually much longer. Some car insurance policies may cover these expenses. We'll discuss this in greater detail in a later lesson. Know for now that the best solution to having your keys locked inside your car is to have a spare set handy.

We recommend you not wait outside your car for the locksmith to arrive as this can attract the attention of someone who may take advantage of you in your situation. Rather, we suggest you wait inside a nearby building or store or with someone else in a vehicle until the locksmith arrives.

Some folks carry an extra set of keys in their purse or keep a spare key on a different set of keys they carry in their pocket. A handy device is a small plastic box capable of holding a single key that is attached to the underneath surface of your car or hidden in the bed of your pickup. It is attached to your car by a very strong magnet. However, these boxes have been known to get dislodged, fall from your car and be lost on the road. If you keep it in the bed of your pickup, you should still be able to find it should it fall free. Overall, these little boxes do work well and can save your having to spend for the services of a locksmith. They can usually be purchased at an auto parts store.

Extra keys can be kept in magnetic key boxes which can be "hidden" beneath your car. Due to being magnetic they'll "stick" to metal surfaces.



Modern car keys are usually accompanied by a fob which is a plastic keychain with an assortment of electronic devices embedded within. Look at the photos here of typical key fobs.



Modern car keys are often accompanied by a fob which has multiple functions such as locking or unlocking doors, opening doors and even starting your car from a remote location.

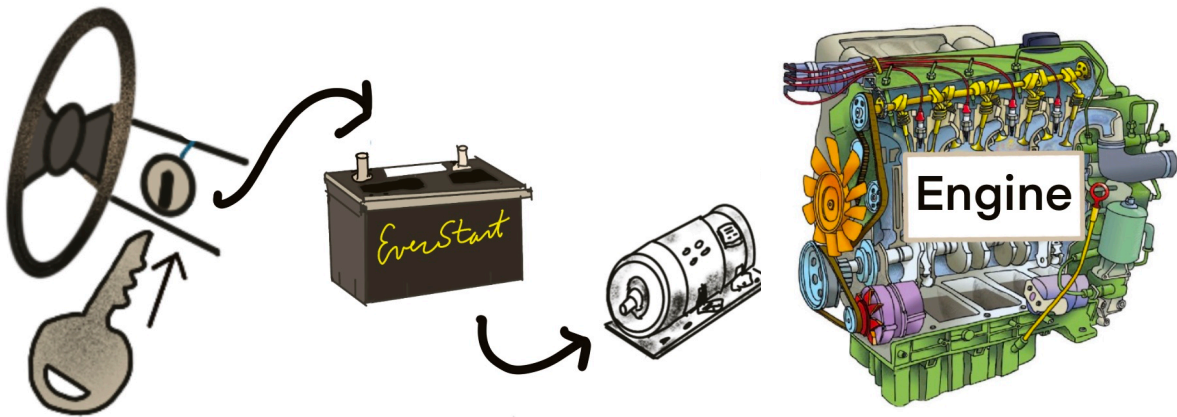


The electronic devices found within a key fob can allow you to do all sorts of tasks while on the outside (or sometime, inside) of your car. Examples include unlocking or locking doors, turning on or off lights or sounding the horn. You may also be able to open back hatch doors or even start your car's engine from a remote location.

Because these electronic key fobs are so sophisticated, it's highly unlikely you would be able to find a replacement at a local hardware or auto parts store should you lose or damage yours. A replacement fob can be purchased through car dealers or through online sales. However, they are much more expensive than just a key to replace. New cars come with two or more fobs. A used car may only come with one. This is another reason to do your best at keeping track of your car keys and the attached fob. There's never a convenient time to lose a set! Make it a habit to always remove your keys from your car each and every time you leave your car. Then, make it a practice of putting them in a consistent location in your home or workplace.

## THE IGNITION SWITCH

As we mentioned earlier, the key of your car fits into the ignition switch. Let's continue exploring how the ignition switch allows your car to run. The ignition switch allows electricity from your car's battery to activate an electric motor under the hood of your car to start your car's engine. Note that we'll be referring to the engine of your car, the thing that uses gas to make



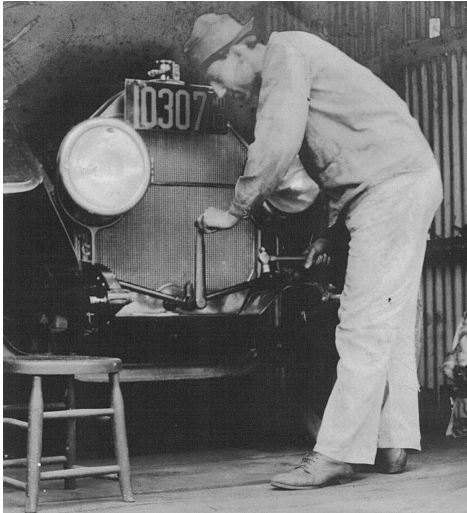
The key will "tell" the battery to give energy to the starter motor which "turns over" the engine of your car to make it start running.

your car zoom down the road, as the engine. Some folks refer to this part as the car's motor and that's perfectly okay. We'll call it the engine in this book as to not confuse it with other devices or motors in other places in your car.

So, the ignition switch allows electricity to flow from your car's battery to activate the starter motor. Note that this is in an electric motor and not the car's engine. It's the job of the starter motor, usually simply referred to as the starter, to turn your car's engine "over." Let's look at this more closely and it should make sense for you.

Before cars had batteries and starter motors, a person had to use a crank on the front of the engine to start it. Look at this old photograph below of a person using such a crank. This is very likely where the saying "crank the engine" originates!

The reason why the engine must be "cranked" or "turned over" is not that the whole engine is flipped over in order to start. The inner parts of the engine must be rotated in order for the engine



In the early days of automobiles, a crank on the front of the engine was used to "turn over" the engine in an effort to get it started. This required great strength and had potential hazards. The electric starter replaced the crank in the 1920s. Photo by Lewis Reed, courtesy of Jeanne Gartner.

to start running on its own. This rotation is what we are referring to when we say “turn over” the engine. The action of rotating these inner parts allows for gasoline to be pumped into the engine, which allows it to be ignited (hence the name ignition switch) and results in the engine running.

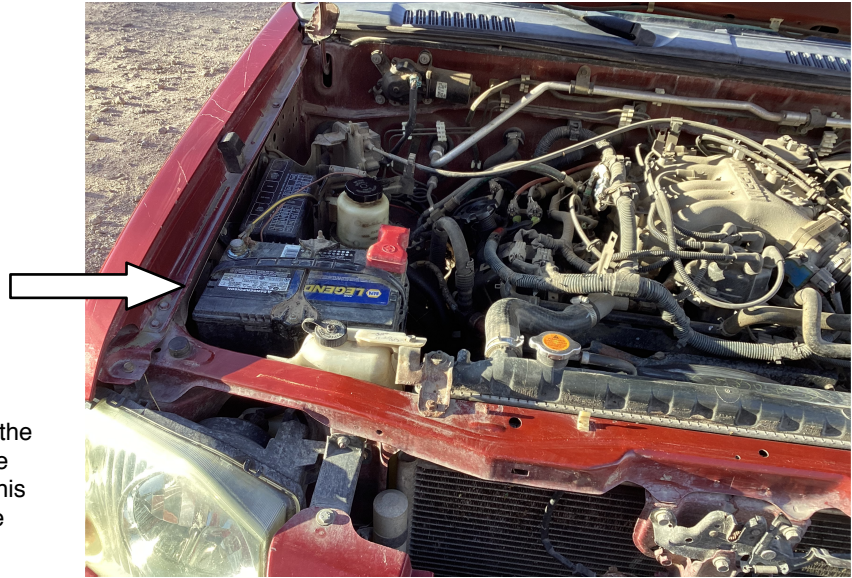
Using a hand crank was hard work, not to mention potentially dangerous. The crank did have an override mechanism in place so that once the car started, the crank would no longer be engaged. However, if the car backfired while starting, the crank could unexpectedly rotate and possibly injure the person doing the cranking. The invention of the electric starter motor eliminated this need to physically crank the engine. The starter motor does the cranking for you!

Before we move on to the battery of a car, let’s review what we’ve learned so far. We’ve learned that it's the car’s key which enable the car’s ignition switch to turn. This turning allows electricity flow to the car’s starter motor, which in turn rotates inner parts of the car’s engine. This turning allows gasoline to be pumped into the car’s engine and be ignited, allowing the engine to begin running on its own.

## THE BATTERY

Let’s take a closer look now at the battery of your car. We’ll do this mainly because a battery that’s not working well can quickly cause major problems in getting your car to start.

The battery is usually located beneath the hood of your car near the front and may be on the left- or right-hand side. Some cars may have the battery beneath a seat of the car so it's a good idea to be familiar with the location of your car's battery.



Car batteries are usually found beneath the hood of your car in the front left or right corner. In some cars, they may be covered. In this pickup, we see the battery in the front left corner.



Car batteries are usually very heavy and must be well clamped into the frame of your car. They are heavy because they are made up of several thin layers of lead housed inside a plastic case. Lead, as you may know, is a very dense metal and, because of this, it's often used to make fishing weights. In the case of car batteries, these sheets of lead are flooded with a very strong acid known as battery acid (sulfuric acid) inside the plastic case. The interaction between the sulfuric acid and the lead results in electrical charge developing at one of the posts of the battery. The posts of the battery are the two cylinder-shaped, metal projections which you find exiting through the case of the battery.



Let's look more closely at the two posts of the battery now. Note that the posts can come from the top or side surface of the battery. It's at the posts where wires connect both to the ignition switch and the starter motor.

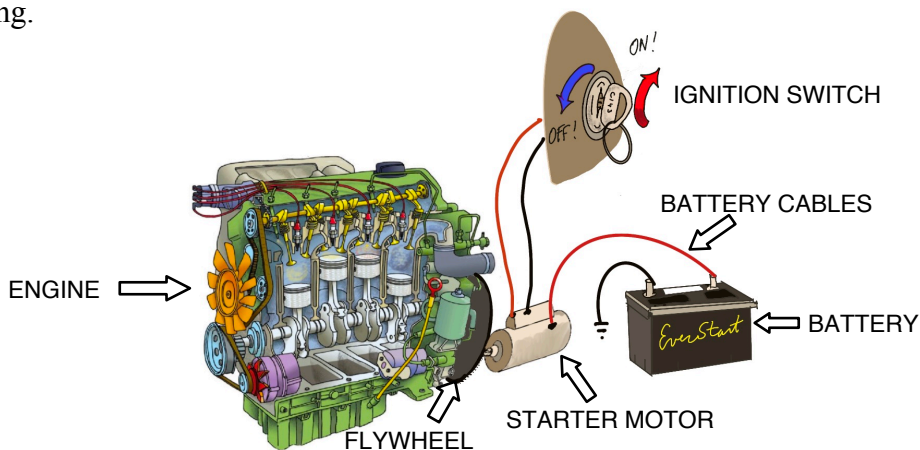
The posts on car and truck batteries can be found on the side of the battery case or on top of the battery case.



The posts on the battery are clearly marked with a plus sign (+) for the positive post and a negative sign (-) for the negative post.



Note how these wires are quite thick in diameter. This is because the battery produces a very large amount of electricity in order to allow the starter motor to do its hard job of “turning over” or cranking the car’s engine. The starter motor is connected by a gear to the engine. When the starter motor is activated, its gear turns which consequently “turns over” the engine causing it to begin running.

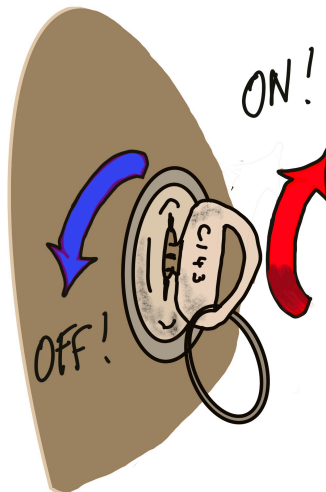


Most car batteries are 12-volt batteries, meaning that the “strength” of the charge which leaves the battery is 12 volts. For comparison, a flashlight battery usually provides about 1.5 volts of charge and household electrical current is about 110-120 volts. So, you may be thinking, “A car battery isn’t really all that much.” However, it's the amperage, or number of amps, which is the speed at which these charges are released from the battery, that make it so *very* powerful (and potentially dangerous) for the user. A car battery can provide upwards of 70-80,000 amps each time a car is attempted to be started. In a house (even though household current is not battery-generated electricity), the amperage is only a fraction of that amount. We’ll look more closely at managing your car’s battery in our lesson on minor repairs and maintenance later in this book.

So, to recap, when you turn the ignition key in the ignition switch, you allow the battery to send electricity over to the starter motor. The starter motor (which is directly connected by a rotating gear to the car’s engine) then causes parts within the engine to turn, eventually getting the car's engine running. Before we look more closely at the car’s engine, let’s first go back briefly to the ignition switch.

If you’ve ever attempted to start a car, you’ve noted that when you turn the key you have to hold it momentarily at its furthest point of rotation in order for the starter motor to be activated. As long as you hold it at this point, the starter motor works to start the engine. It’s important to know that as soon as the engine does start, you should release your thumb pressure upon the ignition

The ignition switch is activated by rotating the key forward. Once the engine starts, the key is released and it moves back to the "on" position. To shut off the engine, the key should be rotated towards you.



switch. The switch will automatically turn a small amount back towards you, yet remain in the “on” position which allows your car to run. Holding the key for too long in the starting position after the engine has started can damage your starter motor. When you need to shut off your engine, you rotate the key back towards you to the off position. The engine should stop running.

## LESSON 1 REVIEW QUESTIONS

Fill in the blank with the appropriate word or phrase. Check your work by referring to the answer key found in the appendix.

1. The \_\_\_\_\_ is the object used to activate the ignition switch.
2. The part of the ignition switch which accepts the key is known as the \_\_\_\_\_.
3. When the ignition switch is turned to the "on" position, electricity will flow from the \_\_\_\_\_ to the \_\_\_\_\_.
4. It's the job of the \_\_\_\_\_ to "turn over" the engine to get it to begin running.
5. Before the invention of the electric starter motor, cars had to be started using a \_\_\_\_\_ which was often dangerous.
6. The car's battery is usually found under the \_\_\_\_\_ of the car but can sometimes be found beneath a \_\_\_\_\_.
7. A car battery is usually very heavy due to sheets of \_\_\_\_\_ found within.
8. The strong acid which reacts with the lead sheets within the battery is known as \_\_\_\_\_ acid or scientifically as \_\_\_\_\_ acid.
9. The two metal projections exiting the case of the battery are called \_\_\_\_\_.
10. There is a \_\_\_\_\_ post and a \_\_\_\_\_ post.
11. The starter motor is connected to the engine through the use of a metal \_\_\_\_\_.
12. A car battery is usually a \_\_\_\_\_ volt battery.
13. When the engine is "turning over" \_\_\_\_\_ is being pumped to the engine to allow it begin running on its own.

Indicate whether the statements below are true or false. Check your work by referring to the appendix.

- \_\_\_\_\_ 1. At one time cars did not have keys rather only buttons or switches to get them started.
  
- \_\_\_\_\_ 2. Keys (usually made of metal) are not unique to individual cars. You can use a key for any car you have.
  
- \_\_\_\_\_ 3. The best place to keep your spare set of car keys is in your house on a key rack or other designated safe place.
  
- \_\_\_\_\_ 4. Key fobs are handy devices which may have functions which allow you to lock or unlock your car doors, sound alarms or even start your vehicle from a remote location.
  
- \_\_\_\_\_ 5. Once the key is inserted into the cylinder, it can be turned to activate a switch which sends electricity from the car's engine to the starter motor.
  
- \_\_\_\_\_ 6. Car batteries have three posts extending from the battery case: a positive post, negative post and a neutral post.
  
- \_\_\_\_\_ 7. The metal which makes a car battery heavy is lead.
  
- \_\_\_\_\_ 8. The battery is attached to the starter motor through the use of battery cables.
  
- \_\_\_\_\_ 9. The job of the ignition switch is to activate the starter motor which "turns over" the car's engine.
  
- \_\_\_\_\_ 10. Once the car's engine is running, you should release your hand pressure upon the switch and allow the switch to return to the "on" position.
  
- \_\_\_\_\_ 11. It's okay to hold down on the ignition switch once your car has started as it won't do it any harm.
  
- \_\_\_\_\_ 12. The action of your engine "turning over" allows gas to be pumped to the engine to make it run on its own.
  
- \_\_\_\_\_ 13. The voltage of a car battery is usually 110 volts which is the same as in your house.
  
- \_\_\_\_\_ 14. The battery in your car is usually found beneath the hood of your car, usually on the left- or right-hand side near the front of the car.
  
- \_\_\_\_\_ 15. If you lock your keys inside your car and you don't have your spare keys handy, the best thing to do is break a window to get them out.

Read each question below. Choose the one best response.

1. The purpose of the key in respect to its use in a car is
  - a. to increase the value of the car.
  - b. to protect your car from being stolen by others.
  - c. to activate the starter motor to "turn over" the engine.
  - d. answers b and c are both correct answers.
  
2. A car battery contains sheets of \_\_\_\_\_ which react with \_\_\_\_\_ to produce electricity.
  - a. paper, glue
  - b. aluminum, battery acid
  - c. steel, nitric acid
  - d. lead, sulfuric acid
  
3. The battery in a car gets connected to the starter motor by heavy wire cables. These cables connect to which portion of the battery?
  - a. battery case
  - b. battery handle
  - c. battery posts
  - d. battery ports
  
4. The connection point between the starter motor and the engine of the car is a
  - a. rubber band
  - b. steel gear
  - c. heavy wire cable
  - d. plastic gear
  
5. Which statement below best describes the relationship between the ignition switch, starter motor and engine of your car?
  - a. The ignition switch allows electricity to flow from the car's battery to the engine. The engine then spins to start to the starter motor which allows your car to run.
  - b. The ignition switch allows electricity to flow from the car's battery to the starter motor. The starter motor then turns causing the engine to "turn over" and eventually begin to run on its own.
  - c. The ignition switch allows electricity to flow from the starter motor motor to the battery. The battery then energizes the key which allows the engine to begin running.
  - d. The ignition switch, when activated by the key, sends electricity to the engine which turns over the starter motor which excites all passengers in your car.