Dear Customer,

NSI International, Inc. is the manufacturer of this kit. We hope you enjoy our Remote Control Kit. If you find that we have made an error or if something is missing or damaged, let us know so that we can correct the problem for you. Please include the following:

- Name of item
- Model number
- Date of purchase
- Place of purchase
- Purchase price (please include sales slip)
- Brief description of the problem

Please do not contact Smithsonian or return the kit to the store where you purchased it. They will not have the replacement parts!

Send all correspondence to:

NSI International, Inc.
105 Price Parkway
Farmingdale, New York 11735-1318
Attn: Quality Control Department
Telephone: 888-425-9113
Customer Service Email: custserv@nsi-int.com

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Important Battery Information

- Non-rechargeable batteries are not to be recharged.
- Rechargeable batteries are to be removed from the toy before being charged.
- Rechargeable batteries are only to be charged under adult supervision.
- Different types of batteries or new and used batteries are not to be mixed.
- Only batteries of the same or equivalent type as recommended are to be used.
- Batteries are to be inserted with the correct polarity.
- Exhausted batteries are to be removed from the toy.
- The supply terminals are not to be short circuited.
- Keep packaging for reference since it contains important information.
NOTICE

The engine you are going to build is a greatly simplified version of a real engine. This will make it easier for you to understand the operation of a four-stroke, internal combustion engine. Consequently, the following components are not included: oil filter, liquid cooling system, air filter, connecting rod bearings, rings, oil pump, fuel pump, alternator and a starter. On the other hand, the following components, which are included so you can identify their location on the engine, are not intended to function: water pump,

What is this kit all about?

First, you’ll identify and assemble the various parts, module by module, with the help of the explanations provided in this manual. Once you’ve done this, you’ll have the pleasure of seeing the four-stroke, internal combustion engine you’ve just built in operation. You’ll also see the spark plugs “fire” in the correct sequence - just like a real engine!

Most engines used in today’s cars and trucks are 4-stroke cycle engines, just like this one.

The explanations in this manual will help you understand how the engine in your parents’ car operates.

Later on you’ll be able to expand your knowledge and become a “whiz” on internal combustion engines.
BEFORE ASSEMBLING YOUR ENGINE WE SUGGEST:

1. First off, thoroughly identify the various components by trying to learn the name of each part. In so doing, make good use of the drawings included in this manual.

2. Remove the parts from the plastic molding as you need them, and strictly follow the order of assembly indicated on the following pages. Otherwise, you will run into problems because you won’t know which number goes with which part (there are no numbers on the parts themselves). In any case, the drawings on the following pages are intended to help you. Refer to them any time you have a question on the identity of a part.

3. After separation from the plastic mold, small burrs may remain on some parts. Remove these burrs by means of a knife or other cutting implement. Otherwise, they could hinder proper operation of the engine. (Have an adult help with this step.)

4. If several screws are to be mounted on the same part, first place all the screws in position and tighten them lightly by hand.

5. Think carefully about the position of each part before attaching it permanently (mind the possibility of installing it upside-down, backwards, etc.). In this regard, note the reference numbers indicated on the assembly drawings shown on the following pages. Otherwise, you may have to start over.

6. You should lightly oil all of the bearings so the various parts of your Motor Works Engine will operate smoothly. Use vegetable oil; there should be some in your kitchen. (Note: A “bearing” is any part of a machine that supports a rotating shaft.)

YOUR GOAL should be to assemble your engine properly on the first try, and to have it operate properly. If you follow these recommendations for assembling your engine, you will accomplish this goal.
**BASIC ENGINE TERMS**

- **ALTENATOR**
  A device for generating electrical current. An alternator generates A.C. (alternating current), but it is rectified into D.C. (direct current) for charging the battery.

- **BATTERY**
  A device for storing electrical energy. Its function is to activate the starter motor and accessories when the engine is first started. The battery is automatically re-charged as long as the engine is running.

- **BOX, CASE**
  The name given to any component in the shape of a box or casing that houses moving mechanical parts. Examples: crankcase, gearbox, differential gear casing.

- **CAMSHAFT**
  A shaft with lumps, or lobes on it that forces each of the intake and exhaust valves to open in the proper sequence.

- **CARBURETOR**
  A device for mixing incoming air with a measured amount of gasoline to produce a gas-air mixture that the engine can run on.

- **CONNECTING ROD**
  A metal arm that attaches the piston to the crankshaft and allows the piston to go up and down in the cylinder as the crankshaft rotates.

- **CRANKSHAFT**
  A metal shaft that takes the up and down action of the pistons and converts it into a rotating motion to drive the vehicle.

- **CYLINDER**
  The chamber in which the piston moves. It is hollowed out of the engine block.

- **CYLINDER HEAD**
  The upper part of the engine (attached to the top of the cylinder block) where the explosions occur. It contains the valves, spark plugs, and the camshaft. This part of the engine heats up considerably and must be constantly cooled.

- **DISPLACEMENT**
  The size of the engine, expressed as cubic inches, cubic centimeters or liters (1000 cubic centimeters). This is the volume of the space inside all of the cylinders that the pistons actually go up and down in.

- **EXHAUST SYSTEM**
  The system that carries the burned gases or exhaust away from the engine after combustion. The system consists of exhaust valves, ports or openings in the engine, exhaust manifold, and pipes that lead to the muffler which quiets the sound of the engine's exhaust.

- **FUEL INJECTION**
  A system that measures and delivers the correct amount of fuel to the cylinders. Each injector, whether mechanical or electrical, squirts a tiny amount of fuel into the engine's intake like a doctor's syringe injects medicine. Used instead of a carburetor, a fuel injection system is more accurate than a carburetor and allows for better performance.

- **FUEL SYSTEM**
  The group of components that feeds gas and air to the carburetor. It includes: the fuel tank, gas filters, the gas pump, fuel supply lines, and the air filter.

- **IGNITION SYSTEM**
  The group of electrical circuits required to ignite the gas-air mixture that is drawn into the cylinders of the engine.

- **INTAKE SYSTEM**
  The system that brings fresh air needed for the combustion process into the engine. The system consists of the air intake duct, air cleaner, intake manifold, intake ports or openings in the engine, and intake valves. A throttle controls the amount of air that enters the intake manifold.

- **PISTON**
  The cylindrically-shaped piece of metal that moves up and down inside the cylinder. It is linked to the crankshaft by the connecting rod. The movement of the pistons governs the four strokes of the cycle invented by Beau De Rochas.

- **ROCKER ARM**
  A series of small arms or levers that actually open the valves when the lobes of the camshaft act on the rocker or a rod, called a push rod, which actually pushes the rocker arm.

- **SPARK PLUGS**
  The device that triggers the explosion in the combustion chamber. It is part of the electrical system. It has two electrodes, one (-) grounded to the engine block and the other (+) connected to the distributor. A small gap separates these two points. When a high voltage (at least 14,000 volts) is applied to the + terminal, an electric arc is formed between this gap igniting the gas-air mixture in the combustion chamber. The spark plug "fires" 10, 25, or even 50 or more times per second, depending on the RPM of the engine.

- **STARTER**
  A small electric motor which is powered by the battery. When the starter is engaged by the ignition switch, the motor spins and a small gear turns the large gear attached to the engine's flywheel, forcing the crankshaft to rotate and the engine to operate. Once the engine starts and runs on its own power, the starter automatically disengages.
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<th>DESCRIPTION</th>
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<td>(half round)</td>
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distributor assembly

drive module

battery box

2 washers (9.5mm in Ø)

kids screwdriver

67 screws

8 valve springs

1 shaft, 3 mm Ø, 206 mm long (half-round)

1 shaft, 3 mm Ø, 156 mm long
1 Assembling the pistons

Insert a piston pin (part 1) through the small end of the connecting rod (part 2).

2 Fit two piston half-heads (part 3) onto the piston pin. Join the piston half-heads by pressing firmly against the sides. They should be solidly connected, and the piston should be able to rotate freely around the piston pin.

Repeat operations 1 and 2 to
3 Mounting the pistons on the crankshaft

NOTE!
Break off the small tongue (marked with a ‘4’) on the crankshaft prior to making the following assembly. Any remaining burrs could subsequently hinder rotation of the crankshaft, so trim them off with a knife. Adult participation is recommended when trimming.

On the crankshaft (part 4) and on the drawing, identify the four locations at which the piston/connecting rod assembly will be mounted. At each location, attach the big end of the connecting rod to the crankshaft.

4

When all four piston/connecting rods have been mounted, check the complete assembly for proper operation as follows:
Grasp the ends of the crankshaft between the thumb and forefinger of each hand.
Rotate the crankshaft.
The pistons should dangle freely.
Mounting the oil pan on the lower housing

Set the oil pan (part 6) on the four lugs protruding from the bottom of the lower crankcase (part 7), as shown in the drawing. Secure the oil pan.

Insert the four mounting studs on the bottom of the lower crankcase/oil pan assembly into the matching receptacles on the
7 Installing the piston-crankshaft assembly in the cylinder block

Position the piston-crankshaft assembly and the cylinder block (part 9) as shown in the drawing. Carefully insert the four piston heads into their respective cylinders in the cylinder block. (Pay close attention to the drawing)

SPECIAL NOTE: Pay close attention to the three screw

8 Mounting the cylinder block assembly on the lower crankcase

Position the oil pan/lower crankcase/engine mounting stand assembly as shown in the drawing. Grasp the ends of the crankshaft/cylinder block assembly with the fingers of each hand, as shown by the drawing. Turn the assembly upside down so it is positioned as shown in the drawing. Set the cylinder block assembly on the lower crankcase unit. Make sure the units are aligned as shown in the drawing, and that you have not reversed the orientation of either unit (lower crankcase and cylinder block studs should stick out to
Fasten the two units together with six screws. Check the overall assembly, at this point, for proper operation: Rotate the crankshaft by hand. The cylinders should move freely up

10 Installing the springs on the valve stems

Slide the spring over each of the
Installing the valves in the cylinder head

Position the lower cylinder head (part 11) as shown in the drawing. Locate the small holes. These are the holds for the exhaust valves. First, insert the ends of four valve stems in these holes, one by one (the springs are too large to slip through the holes).

Now repeat the following operations for each of the four valve stems:
- Using your finger, press down on the upper end of the valve stem to compress the spring. The other end of the valve stem will now be exposed below the cylinder head. Press the exhaust valve (part 13-the small ones)

In the same manner, install the other four valve stems (and springs), this time in the large holes. Press an intake valve (part 14-the large ones) onto the lower end of each valve stem. Press firmly so the two parts will remain locked together.

Check to see that all eight of the valves you have just installed work properly:
- Press on the spring end of each valve, one by one.
- The valves should open and close their respective holes as you press and release each valve stem. The action should be smooth, somewhat like the keys of a piano.
Mounting the rocker arms on the rocker arm shaft

Collect the eight rocker arms (part 24) and the rocker arm shaft (round shaft, 3 mm in ø, 156 mm long). Slip each rocker arm onto the shaft, one by one. Rotate every other rocker arm 180° so that the long and short segments of each arm alternate (see diagram). As a check: the first and the last rocker arms...

Installing the rocker arm assembly in the upper cylinder head

Hold the rocker arm unit that you have just finished assembling (step 13) over the upper cylinder head (part 23). Carefully lower the rocker arm unit into position (see drawing). Two rocker arms go into each of the four openings. Use your fingers to separate the four pairs of arms. Each arm of these four...

Position the five bearings (part 25) as shown in the drawing. Attach them to the cylinder head by means of 10 screws. When finished, check that the rocker arms pivot freely around
**16 Installing the head gasket on the cylinder block**

The head gasket (part 10) is attached by means of six screws passing through holes in the gasket: two at each end and two in the middle. There are also two holes used for alignment. Using a ballpoint pen, punch the cardboard out of these eight holes in the head gasket. Place the head gasket on the upper lip of the cylinder block. Note the two lugs protruding from the upper lip. They keep the head gasket in the correct position.

**17 Mounting the lower cylinder head on the cylinder block**

**NOTE!**

Before starting this step, carefully note the details shown in the drawing. This will help you properly orient the cylinder head.

Position the lower cylinder head over the cylinder block. Prior to joining the two units make a final check on the orientation of the cylinder head and block. Note how the screws line up with the dashed lines on the drawing. When you are satisfied that everything is lined up properly, fasten the lower cylinder
Assembling the camshaft

There are two ways you can identify the cams:
- Each cam is stamped with a letter (A-H)
- Each cam is marked with a notch; the position of each notch must

Now, slide the cams on the camshaft (half-round shaft).

**Note:** Strictly follow the mounting sequence given below because each cam has a different orientation angle. Slide the cams onto the camshaft in the following order: 1st=A; 2nd=B; 3rd=C; 4th=D; 5th=E; 6th=F; 7th=G; 8th=H.

Installing the camshaft on the lower cylinder head

First, make sure the splined (grooved) end of the crankshaft is to your left. With the camshaft oriented as shown in the drawing (cam H to your left), place the camshaft on the lower cylinder head. Each end of the camshaft is supported by grooves (bearings).
Placing the upper cylinder head/rocker arm unit (assembled in step 15) over the lower cylinder head/camshaft unit (assembled in step 19). Check the orientation of the two units carefully; the

NOTE!

Before attaching the upper cylinder head with screws, you should check that the rocker arms are correctly positioned over the top of the valve stems. The way to do this is to actuate each rocker arm with your finger. The arms should push against the valves. Take care not to pull on the ends of the camshaft. Otherwise, the cams may shift their position and you will have to realign them again.

When you are satisfied that everything is properly positioned, attach the upper cylinder head to the lower

21 Attaching the rocker arm cover

Place the rocker arm cover (part 26) over the upper cylinder head. Attach the cover to the upper cylinder head by means of six
Mounting the timing gear on the crankshaft

Put the timing gear (part 27) on the splined end of the crankshaft.

**NOTE!**

There is only one correct position for this part. Note the reference marks on the drawing. Make sure the reference marks on the parts match those shown in the drawing. This gear must slide freely onto the crankshaft. If you have to force it, then the positioning is incorrect.

Mounting the timing wheel on the camshaft

Press the timing wheel (part 28) onto the camshaft while pushing against the opposite end of the camshaft with your finger to prevent the camshaft from moving. If the camshaft moves, you will have to
Installing the alignment tool

The alignment tool is used to lock the position of the timing wheel while the timing belt is being installed. Carefully identify the reference marks and holes that let you correctly position the alignment tool (part 29) between the timing wheel and the timing gear.

Installing the timing belt and timing belt pulley

Place the timing belt (green color) over the timing gear and timing wheel. Mount the belt pulley (part 30) on the upper post sticking out from the cylinder block (the smooth side of the timing belt rests against the pulley). Once these two steps have been performed, remove the alignment tool; it must not remain attached to
Installing the timing belt cover

Mount the timing belt cover (part 31) as shown in the drawing.

Installing the water pump

Press the rear half of the water pump (part 32) onto the three studs on the timing belt cover; make sure it is oriented as shown in the drawing.
Place the front half of the water pump (part 33) against the rear
28 Installing the fan belt pulley and fan

Place the fan belt pulley (part 34) over the shaft sticking out from the water pump. Make sure it is oriented as shown in the drawing. Attach the pulley to the shaft using a screw and a washer.

Identify the outside face of the fan (part 35) (the outside face has ribs - see drawing!)

Hold the fan against the fan belt pulley with the outside of the fan

29 Installing the crankshaft pulley and fan belt

Place the crankshaft pulley (part 36) against the circular shoulder at the bottom of the timing belt cover. Position the pulley as shown in the drawing. Attach the

The screw passes through the hole in the timing belt cover and screws into the end of the crankshaft. Pass the fan belt (black color) over the top of the fan blades and install it on the fan belt
Installing the flywheel clutch

Mount the flywheel clutch (part 37) on the opposite end of the crankshaft.
Next, we’ll check the entire engine by rotating the crankshaft by hand. Notice carefully what happens.

Positioning the pistons and camshaft

Preliminary adjustment:
Gently rotate the crankshaft by hand until piston Number 1 is at the top of its vertical travel. (This position is called “dead center”). The flat portion of the half-round camshaft should be horizontal, with the flat portion facing upwards.
Once you have verified that the piston and the camshaft are in
Installing the batteries

In the Motor Works kit, electric power is provided by two 1.5 volt batteries (type AA). Take a look at the battery box: inside the box you will see the outline of two batteries showing the polarity (+ and -) of each battery. Install the batteries as follows:

- Push the + end of the battery against the spring.
- Press the - end of the battery downwards until it is firmly seated in its compartment.

CAUTION

Never attempt to connect the kit to the AC mains supply (110-220 volts). Never connect the circuits of the kit to any unit powered by the mains, even if the unit is switched off.

BATTERY SAFETY INFORMATION:

- Only batteries of the same or equivalent type as recommended are to be used.
- Do not mix old and new batteries.
- Do not mix alkaline, standard (carbon-zinc) or rechargeable (nickel-cadmium) batteries.
- Do not attempt to burn batteries.
- Dispose of batteries safely and correctly.

Installing the distributor assembly

Mount the distributor on the camshaft such that the identification marks 1, 2, 3, and 4 are at the top. Attach the distributor with three screws, but do not tighten them yet. Mind that the position of the piston and camshaft (established in step 31) do not shift. The distributor has an inner socket that spins. Turn this socket using the screwdriver until the flat side is facing up. All of the wires from the
Adjusting the ignition

Carefully identify lamp Number 1 by following the blue wire from the “1” mark on the distributor. (Lamp Nr. 1 is the “spark plug” for cylinder Nr. 1) Adjust the ignition system as follows:
• Gently rotate the distributor housing until lamp Nr. 1 lights.
• With lamp Nr. 1 lit, tighten the three distributor screws.
• Remove the distributor plug from the battery box socket.
The ignition system is now fully adjusted. You can now continue

Installing the spark plugs

Insert the four spark plugs in their respective receptacle in the lower

NOTE!

Pay careful attention to the order in which the four spark plugs are installed. Trace each blue wire to ensure that plug Nr. 1 goes to the “1” hole in the lower cylinder head. Nr. 2 goes to the “2” hole, etc.
36 Attaching the drive module

Position the drive module by meshing its gear teeth with those on the flywheel clutch. Attach the module to the engine.

37 Attaching the clutch cone

Feed the wire from the drive module through the opening in the clutch cone (part 38). Line up the three holes in the clutch cone with the three studs on the engine.
Mounting the carburetor and the intake manifold

Place the carburetor bowl (part 39) on the intake manifold (part 40). Attach the carburetor cover (part 41) by means of a screw into the intake manifold/carburetor bowl assembly.

Now install the intake manifold/carburetor assembly you have just finished on the engine. Note that it

Installing the dipstick

Insert the dipstick (part 43) in the cylinder block. The hole for the dipstick is also on the side oppo-
40 Installing the exhaust manifold

On the spark plug side of the engine, install the exhaust manifold (part 42) in the lower cylinder.

41 Operating the engine

The long-awaited moment has arrived! You will now have the opportunity to run your engine for the first time. First, plug the cables from the distributor and the drive module into the battery box. When the latter cable is connected, the engine should start to turn. Note the direction in which the fan blades turn. Theoretically, the fan blades of all automotive engines turn in the same direction.

Did you know this?
Removing the drive module plug from the battery box stops the engine. By successively connecting and disconnecting this plug, you can start and stop the engine just as if you were plugs are “firing”. This will help you understand the operating principle for a 4-stroke internal combustion.
CONGRATULATIONS!
You have successfully built your own model engine. Please observe your engine. It should look like the drawing.
Internal Combustion

The Motor-Works model shows the basic parts of a four cycle internal combustion gasoline engine. This is the most common type of gasoline engine and is the kind used in most cars and trucks.

The power of an internal combustion engine comes from the carefully controlled burning of fuel inside the cylinder. That’s why it’s called an “internal combustion” engine - it literally means “burning inside.” Internal combustion engines are generally about twice as efficient as “external combustion” engines, like the old steam engines.

Internal combustion engines were invented in the 1860s, but it was the German engineer Nikolaus August Otto who in 1867 patented the four-stroke “Otto” cycle engine that we use today. This is the kind of engine shown in the Motor-Works model. All “four-stroke” engines work in the same way and have the same basic parts inside. These are shown in the drawing.

Understanding how these parts work will let you understand the basic principles of all engines.

To begin with, gasoline mixed with air is burned in the Combustion Chamber above the Piston. The gas/air mixture comes into the chamber through the Intake Valve and is ignited by a spark from the Spark Plug. The waste gases that remain after the gasoline burns are pushed out of the engine through the Exhaust Valve. The round Piston that moves up and down in the Cylinder is connected to the Crankshaft by the Piston Rod. As the piston moves up and down, the “rod” turns the Crankshaft and changes the up/down motion of the piston into rotary power.
The four cycles – or “strokes” – of an engine are “Intake”, “Compression”, “Power” and “Exhaust”. These repeat again and again in the same order as the piston moves up and down in the cylinder. Since most engines have more than one cylinder, these cycles are alternated in the different cylinders to reduce vibration and make the engine run smoother. In the Intake stroke, the piston is descending and the Intake Valve is open. Since the piston is tightly sealed against the walls of the cylinder, it pulls the gas/air mixture into the cylinder behind it.

In the Compression stroke, the piston has gone down as far as it can and is now moving back up. Both valves are closed, so the gas has no place to go and is “compressed” by the piston.
In the Power stroke, the piston has just reached the highest point it can travel when the spark plug ignites the fuel. The gas literally explodes and pushes the piston rapidly down. This provides the engine's power.

In the Exhaust stroke, the piston has again gone as far down as it can and is now moving back up. The exhaust valve is open and the piston pushes the "exhaust" gases out of the cylinder as it rises. As soon as the piston reaches the top of the cylinder, the exhaust valve closes, the intake valve opens and the cycles begin again.
Fuel and Air – The Explosive Mixture

As we said earlier, the power in a gasoline engine comes from carefully burning a mixture of gasoline and air. The part of the Motor-Works engine that mixes gas and air is called the carburetor.

A carburetor adds gas to the air as it flows into the engine. It takes a surprisingly small amount of gasoline to provide the push needed in each power stroke. On average, it only takes about 10 milligrams per stroke, but the mixture is very sensitive. If too much gas is put in the cylinder, the engine “runs rich.” Not only will the engine waste fuel, but it will produce smoky exhaust, run poorly (stall easily and hesitate on acceleration) and it may not even run at all. If not enough gas is put in the cylinder, the engine “runs lean.” A lean mixture can keep the engine from starting and can even damage it.

To provide a more precise mixture and to reduce exhaust pollution, the carburetor has now been replaced on automobiles by a system called fuel injection. Since 1991 every new car sold in the United States has used fuel injection, but smaller engines like those on lawn mowers and chainsaws continue to use carburetors because they are simple and inexpensive.

Several other systems have been developed to control the mixture of fuel and air that goes into an engine. Superchargers and Turbochargers both used a pressurized mixture of air and gas to increase the power that can be produced by a gasoline engine.

Starting the Car

The power that starts a car comes from the battery. Once it is running, an electric generator (called an Alternator) that is connected to the motor by a pulley produces all the electricity the engine needs to run. Indeed, although it is not recommended, a car’s battery can actually be removed once it is running.

When you turn the key on an automobile to “Start”, power from the battery goes to the Starter Motor, which turns the crankshaft and moves the pistons. At the same time, electricity goes to the Ignition Coil, where the voltage is increased to 15,000 volts. This high voltage electricity, which is needed to produce a strong spark, is sent to the spark plugs to ignite the gas/air mixture. As soon as the gas in the cylinders begins to explode, the engine can run on its own and the key can be turned back to the “On” position.

The first gasoline engines had no battery. To start them, the crankshaft had to be turned mechanically and a device called a “magneto” would provide the electricity to fire the spark plugs. This is why early cars like the Ford Model “T” had a crank in the front that had to be turned to start them. Later this was replaced by batteries and mechanical ignitions. Today most cars and trucks have what is called an Electronic Ignition system, which is more reliable and produces more power with few emissions.
Heat

Most of the energy produced by the gas consumed in an internal combustion engine is converted into power to do work. But a significant amount of energy in the form of heat is also produced. Temperatures inside modern automobile engines can easily reach 1700 degrees Celsius and engines must be cooled, even in the winter. Four-cycle engines usually use two methods to remove this heat.

Convection

As the Motor-Works model shows, a fan is often attached to the front of the engine and blows air over it to help keep it cool. Some engines, like those on lawnmowers also have metal fins to increase the surface area of the engine and make it easier for heat to escape.

Radiators

For large and powerful engines like those in cars and trucks, most of the cooling is done by circulating fluids that pass through channels in the engine. This fluid is kept moving by a “water” pump which is powered by the engine. The coolant absorbs heat as it passes through the engine and then releases the heat to the air as it passes through the Radiator. A radiator is just a series of narrow tubes with fins that allow air to flow over them and remove the heat. Radiators are almost always located at the front of the vehicle to make it easy for the air to pass over them. Many modern cars have an electric fan that continues to cool the engine after it is turned off. Sometimes you can hear these fans running as you walk away from the car on a hot summer day.

Lubrication

The moving parts in an engine must be precisely made to work properly. To reduce the friction between these parts as they move, it is necessary to lubricate them with oil. Car and truck motors use several quarts of oil to keep everything lubricated and this is stored in the Oil Pan at the bottom of the engine. Every engine has a Dip Stick that reaches down into this oil and lets you make sure that the engine has enough.

An Oil Pump, mechanically connected to the engine, circulates oil throughout the engine. The cylinder walls are lubricated by oil that is splashed by the moving crankshaft. As it circulates, the oil also carries away dirt and chemicals left over from combustion. These are removed by the Oil Filter.

Further Reading

To learn more about internal combustion engines and how they work, check with the public library or search the World Wide Web for terms like “internal combustion.”
The Smithsonian Institution

The Smithsonian Institution is home to more than 141 million objects, ranging in size from insects and diamonds to locomotives and spacecraft. It is the world’s largest museum complex, comprising 15 museums and galleries and the National Zoo in Washington DC, and two additional museums in New York City. Millions of visitors each year visit the nation’s capital to view such treasures as the Hope Diamond, the Star Spangled Banner, and the Wright Flyer. A broad range of exhibits ensures a fun and educational experience for young and old alike.

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History

James Smithson (1765 – 1829), a British scientist, drew up his will in 1826 naming his nephew, Henry James Hungerford, as beneficiary. Smithson stipulated that, should the nephew die without heirs (as he did in 1835), the estate would go to the United States to found “at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge…”

On July 1, 1836, Congress accepted the legacy bequeathed to the nation by James Smithson, and pledged the faith of the United States to the charitable trust. In 1838, following approval of the bequest by the British courts, the United States received Smithson’s estate—bags of gold sovereigns—then the equivalent of $515,169. Eight years later, on August 10, 1846, an Act of Congress signed by President James K. Polk, established the Smithsonian Institution in its present form and provided for the administration of the trust, independent of the government itself, by a Board of Regents and Secretary of the Smithsonian.

SMITHSONIAN MUSEUMS, GALLERIES AND ZOOS

Smithsonian Institution Building (“Castle”)  National Museum of American History, Behring Center
Anacostia Museum  National Museum of the American Indian
Arthur M. Sackler Gallery  National Museum of Natural History
Arts and Industries Building  National Portrait Gallery
Cooper-Hewitt, National Design Museum  National Postal Museum
Freer Gallery of Art  National Zoological Park
Hirshhorn Museum and Sculpture Garden  Renwick Gallery
National Air and Space Museum  S. Dillon Ripley Center
National Museum of African Art  Smithsonian American Art Museum