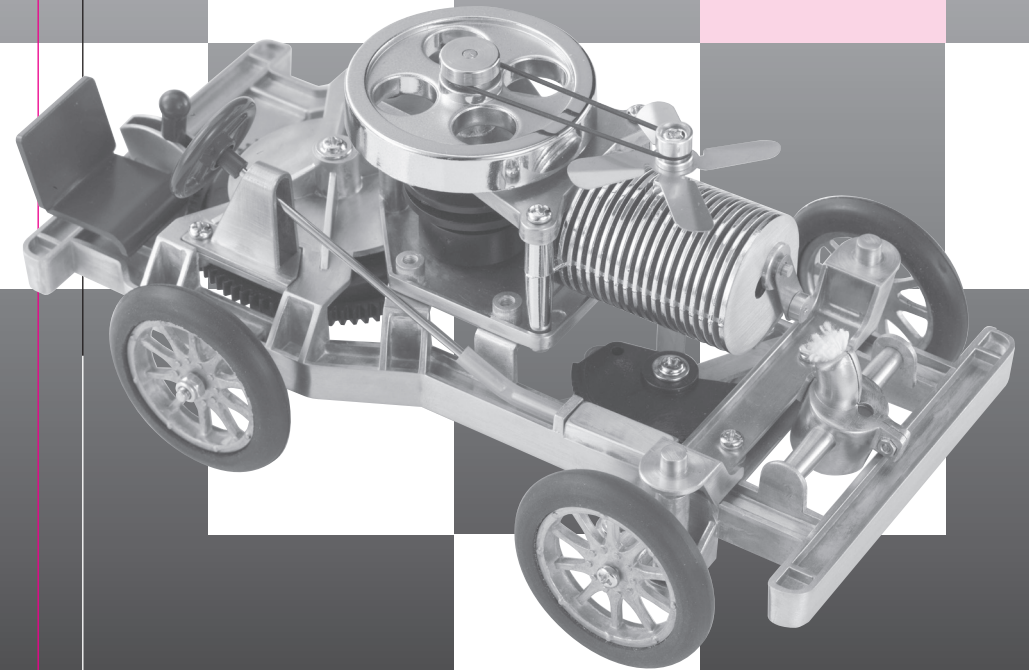


Gakken PRESENTS
Otona no Kagaku
(Science for Adults)
Product Version

Vacuum Engine

Instructions for Assembly and Operating

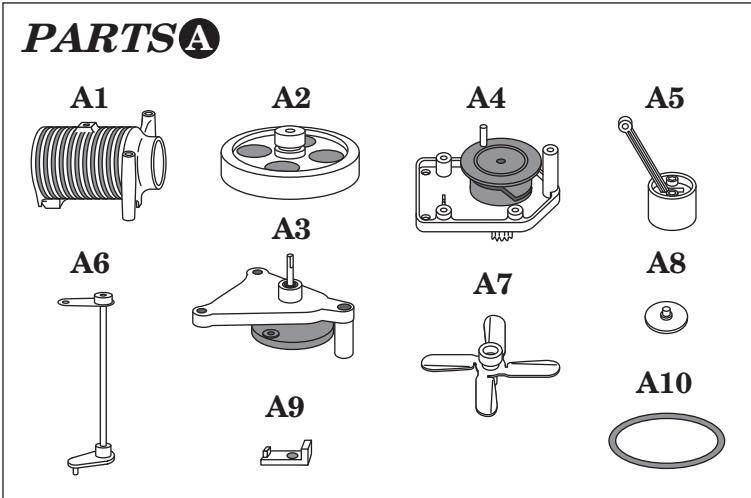


VACUUM ENGINE

Parts List

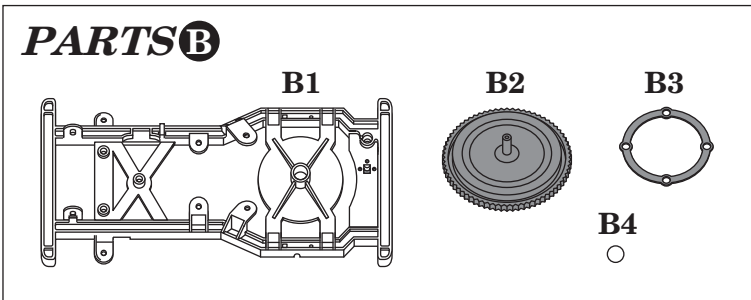
PARTS A

- A1: Cylinder
- A2: Flywheel
- A3: Crank unit (top)
- A4: Crank unit (bottom)
- A5: Piston unit
- A6: Valve rod
- A7: Cooling fan
- A8: Valve
- A9: Valve rod stopper
- A10: Fan belt



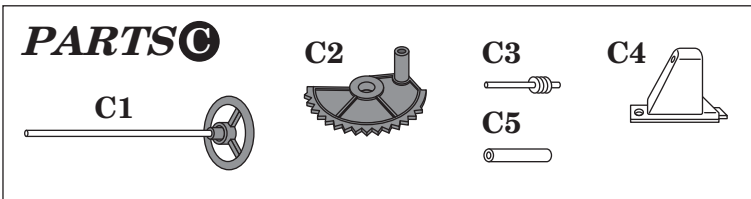
PARTS B

- B1: Car body
- B2: Drive gear
- B3: Bearing guide
- B4: Bearing (5)



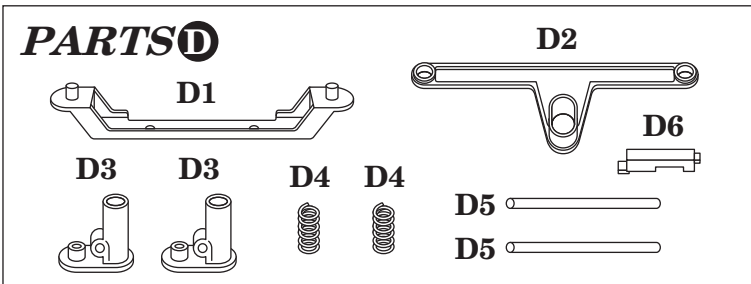
PARTS C

- C1: Steering wheel
- C2: Steering gear
- C3: Worm gear
- C4: Steering-wheel holder
- C5: Universal joint



PARTS D

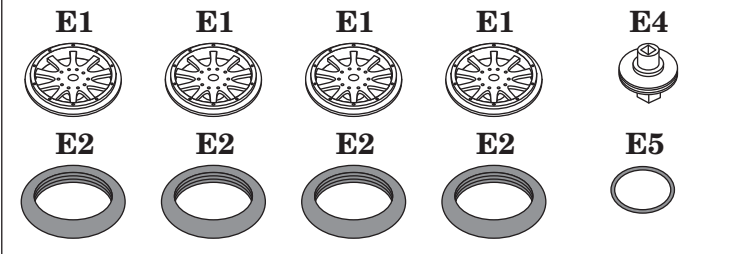
- D1: Upper arm
- D2: Tie-rod
- D3: King pins (2)
- D4: Springs (2)
- D5: Center shafts (2)
- D6: Worm gear cove



* NOTE: The actual shapes of some parts may differ from the illustrations above.

Vacuum Engine

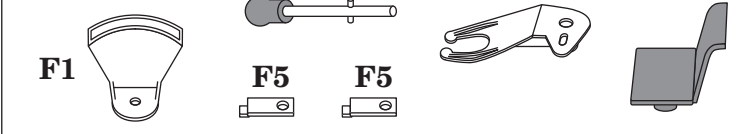
PARTS E



PARTS E

- E1: Wheels (4)
- E2: Tires (4)
- E3: Rear shaft
- E4: Clutch wheel
- E5: O-ring

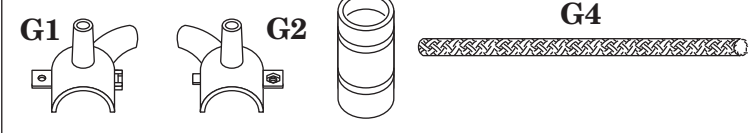
PARTS F



PARTS F

- F1: Clutch box
- F2: Clutch lever
- F3: Clutch guide
- F4: Seat
- F5: Shaft stoppers (2)

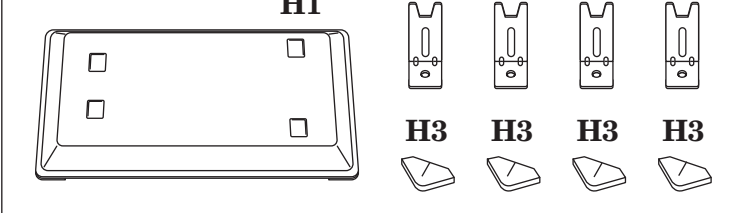
PARTS G



PARTS G

- G1: Fuel tank attachment part A
- G2: Fuel tank attachment part B
- G3: Fuel tank (2)
- G4: Wick

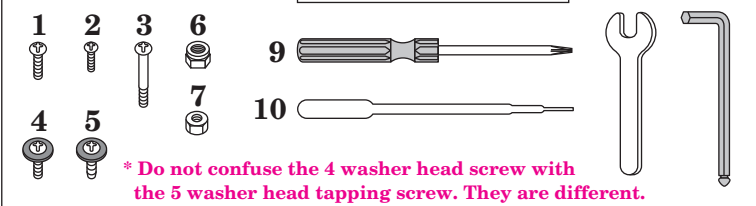
PARTS H



PARTS H

- H1: Stand
- H2: Car body holders (4)
- H3: Non-slip pads (4)

TOOL&PARTS



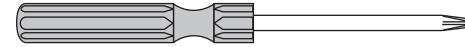
* Do not confuse the 4 washer head screw with the 5 washer head tapping screw. They are different.

CAUTION: The kit may contain more screws, etc. than actually required, for use as spares.

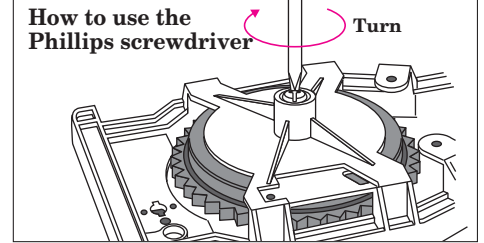
Before Assembling the Kit

1. How to use the supplied tools

● Phillips screwdriver



The screwdriver is used for fastening screws, etc.

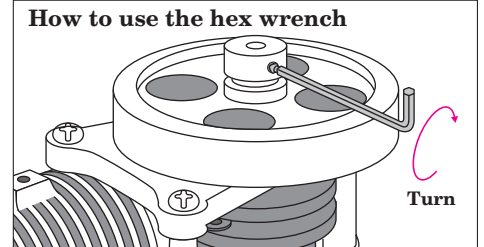


2. How to use the hex wrench

● Hex wrench



The hex wrench is used for installing the flywheel.

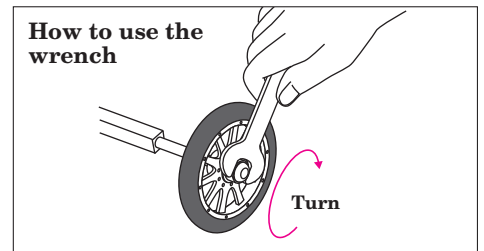


3. How to use the wrench

● Wrench



The wrench is used for tightening nuts.

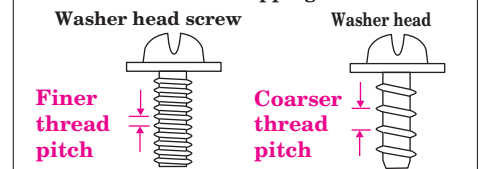


4. Difference between the washer head screw and the washer head tapping screw

When turned, the washer head tapping screw for plastic cuts its own threads as it is driven into the material.

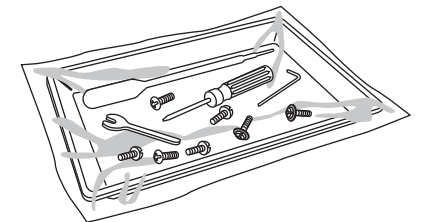
The washer head tapping screw has a coarser thread pitch than the washer head screw.

Difference between the washer head screw and the washer head tapping screw



5. Small parts

The kit contains many small parts. Be careful so as not to lose them. We recommend that you turn the stand over and use it as a tray for holding the small parts.



* In addition to the parts and tools supplied, have on hand alcohol fuel, a pair of scissors, a towel, tissues, and aluminum foil. Alcohol fuel can be purchased at drugstores.

CAUTION: Please read the following instructions before using this kit.

Use this kit only for its intended purpose.

Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire.

Never touch the cylinder while the engine is running. There is a risk of burning.

The cylinder will remain hot for a while after you have completed the experiment. Do not touch the cylinder. There is a risk of burning. When touching it, do so after making sure that it has cooled sufficiently.

Take necessary caution when handling any metallic parts. There is a risk of injury.

There are small parts such as screws. Be careful not to swallow them. There is a risk of suffocation.

Take caution not to poke your hands or eyes, with the supplied screwdriver and the like. There is a risk of injury.

Do not operate the machine on the road. There is a risk of traffic accident.

* Please read the assembly and operating instructions and cautions in this manual thoroughly before attempting to assemble this kit. In addition, do not use any parts that have become damaged or deformed during use.

* Store the kit in a location out of the reach of small children.

CAUTION: Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire. Do not allow children 15 years of age or younger to conduct the experiment without adult supervision.

Plastic materials used in this kit •

Drive gear, steering gear (black): POM Seat, steering wheel, clutch lever (brown): PS Screwdriver handle (orange): Polyethylene Small bags (transparent and colorless): Polyethylene

Metallic materials used in this kit •

Car body, stand, and other body parts: Aluminum Shaft: Iron Valve: Brass Screws, etc.: Iron (nickel plated)

* Please dispose of this product in accordance with local regulations.

1 Assembling the Engine

Parts to be used PARTS A

* The kit may contain more screws, etc. than actually required, for use as spares.

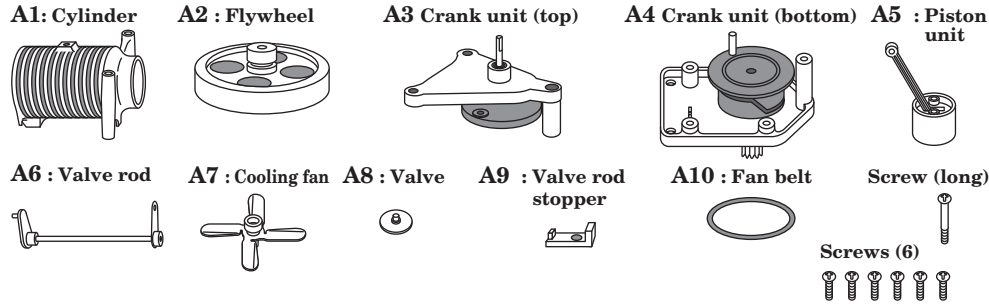
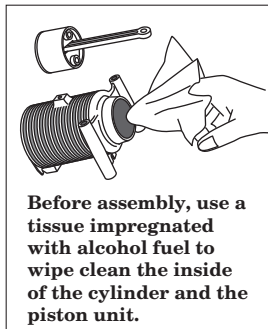


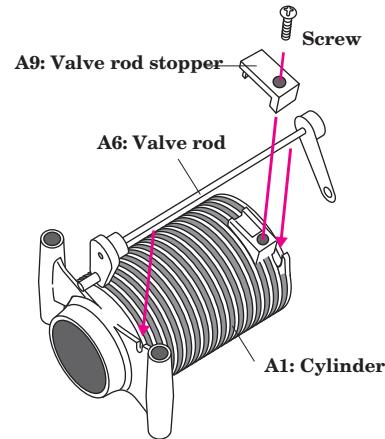
Figure-(1)
Set the A6 valve rod in the A1 cylinder, and install the A9 valve rod stopper using a screw.

Figure-(2)
Insert the A5 piston unit into the A1 cylinder. (If the A1 cylinder or the A5 piston unit is contaminated with grease, use alcohol fuel to wipe it clean.)



CAUTION: Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire. Do not allow children 15 years of age or younger to conduct the experiment without adult supervision.

(1) Install the valve rod.



(2) Insert the piston unit into the cylinder.

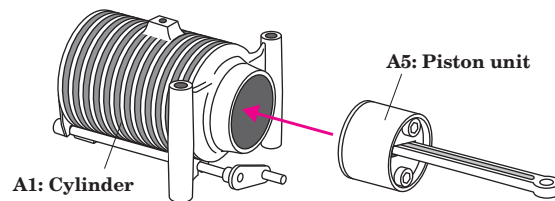


Figure-(3)
Install the assembled A1 cylinder in the A4 crank unit (bottom).
At this point, fit the A6 valve rod into the groove on the A4 crank unit (bottom).
At the same time, insert the pin of the A4 crank unit (bottom) into the A5 piston unit.
Finally, use the screws to secure the A5 piston unit from the bottom side.

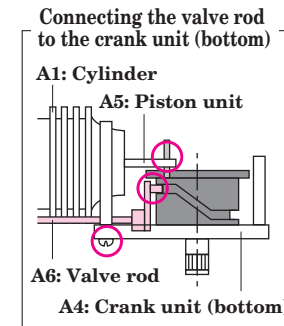
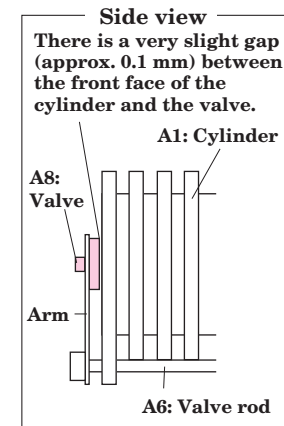
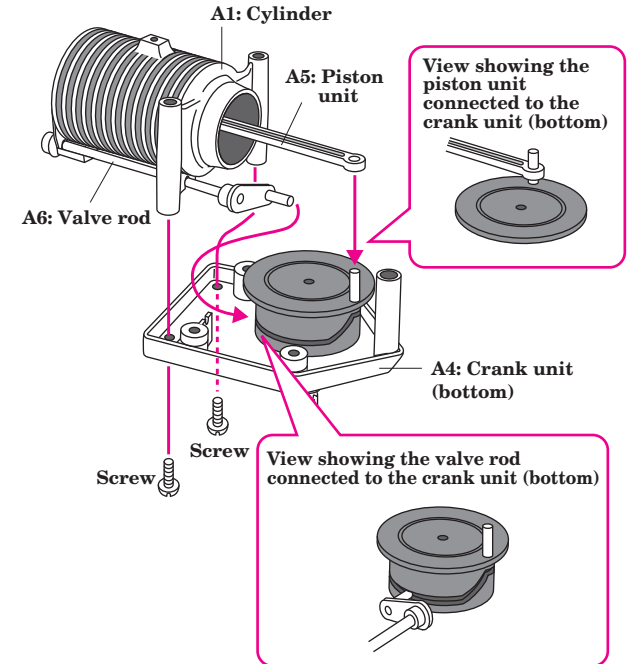


Figure-(4)
Insert the A8 valve into the space between the A1 cylinder and the A6 valve.
At this point, slightly lifting the arm part of the A6 valve rod will make insertion easier.



(3) Install the cylinder in the crank unit.



(4) Install the valve.

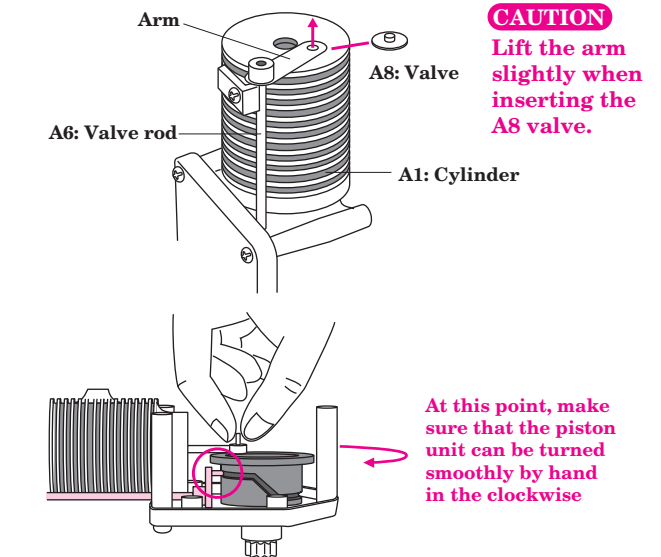


Figure-(5)
Using three screws, install the A3 crank unit (top) onto the crank unit (bottom) assembled in Figure-(4). For this step, connect the A3 crank unit (top) to the pins of the A4 crank unit as shown in the figure. (The result is shown in the figure below.)

Cross sectional diagram of the connection area

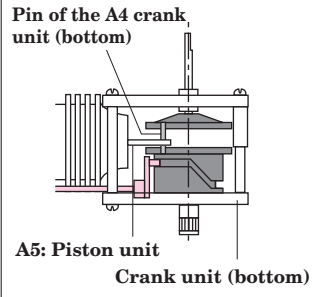


Figure-(6)
Using the hex wrench, turn the flywheel installation screw and install the flywheel.

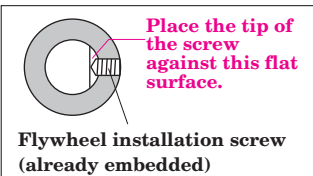
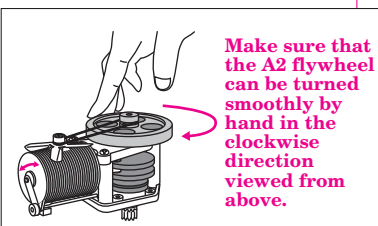
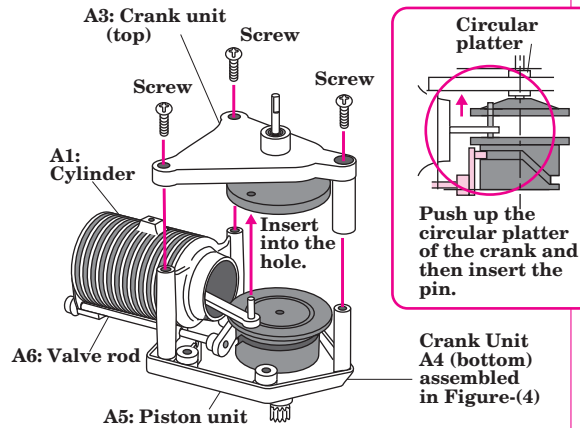


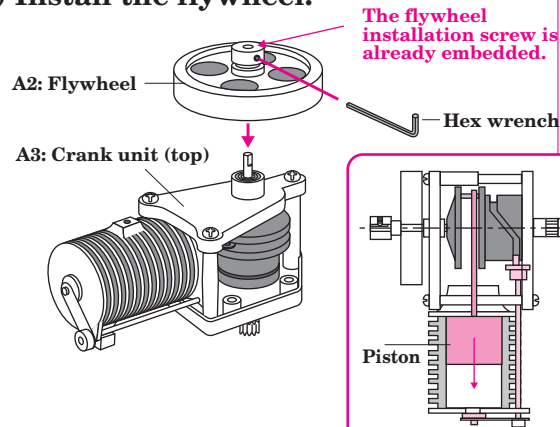
Figure-(7)
Use the screw (long) to secure the A7 cooling fan to the A1 cylinder. Then, use the A10 fan belt to connect the A7 cooling fan to the A2 flywheel.



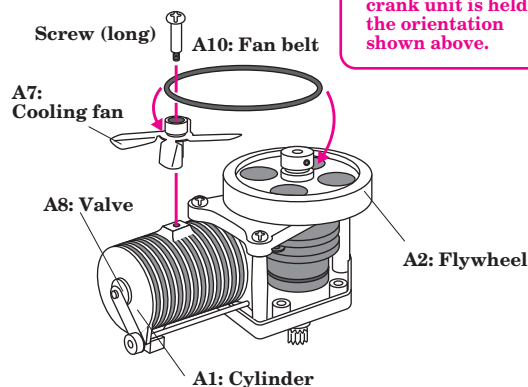
(5) Install the crank unit.



(6) Install the flywheel.



(7) Install the cooling fan.



2 Installing the Drive Gear in the Car Body

Parts to be used PARTS B * The kit may contain more screws, etc. than actually required, for use as spares.

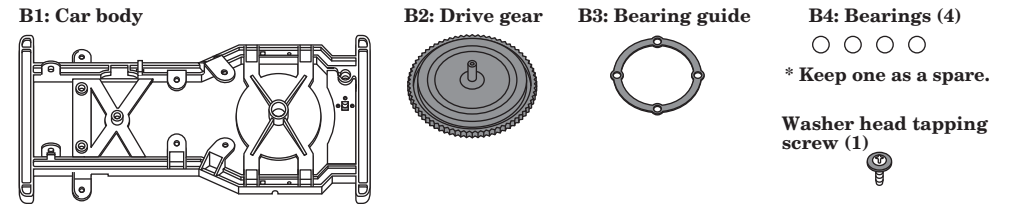


Figure-(8)
Place the B3 bearing guide on the B2 drive gear and set all four B4 bearings in the B3 bearing guide.

(8) Install the bearing guide with bearings in the drive gear.

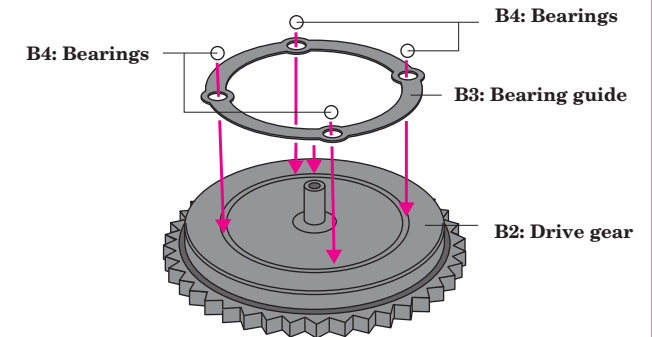
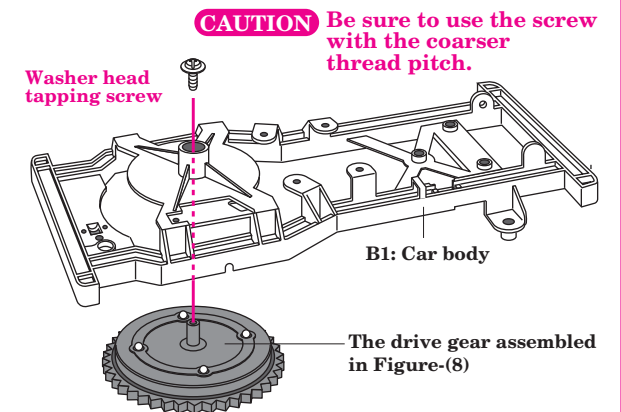


Figure-(9)
Use the washer head tapping screw to secure the drive gear assembled in Figure-(8) to the car body. During this step, be careful not to lose the bearings.

(9) Install the drive gear with bearings onto the car body.



CAUTION: Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire. Do not allow children 1 years of age or younger to conduct the experiment without adult supervision.

3 Installing the Steering Wheel in the Car Body

Parts to be used PARTS C

* The kit may contain more screws, etc. than actually required, for use as spares.

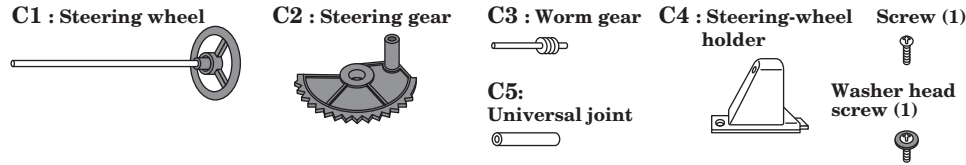


Figure-(10)
Insert the C4 steering-wheel holder into the slits in the B1 car body, and secure it with the screw.

(10) Install the steering-wheel holder.

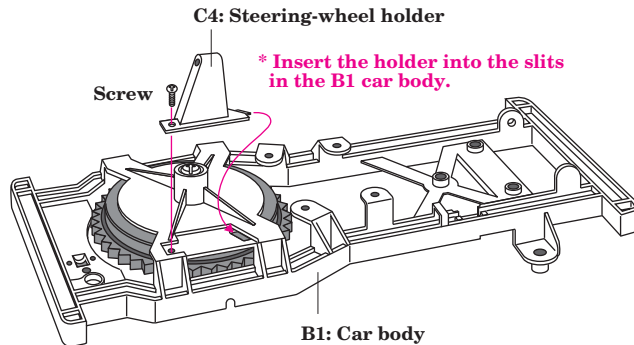
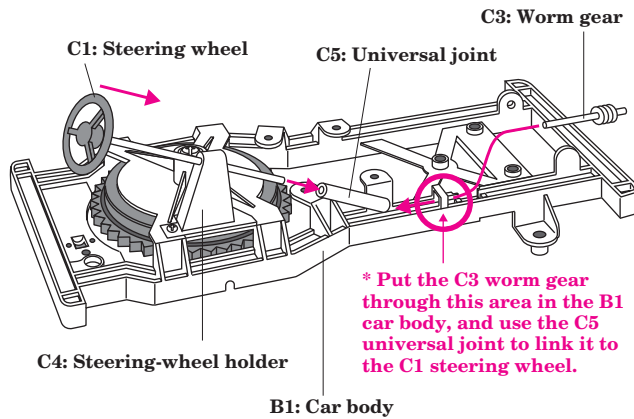
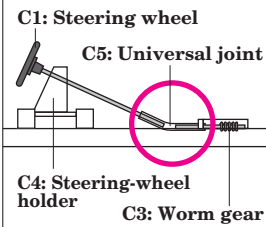


Figure-(11)
Pass the C1 steering wheel through the C4 steering-wheel holder. Next, set the C3 worm gear in the B1 car body. Lastly, use the C5 universal joint to link the C1 steering wheel to the C3 worm gear.

(11) Install the steering wheel.



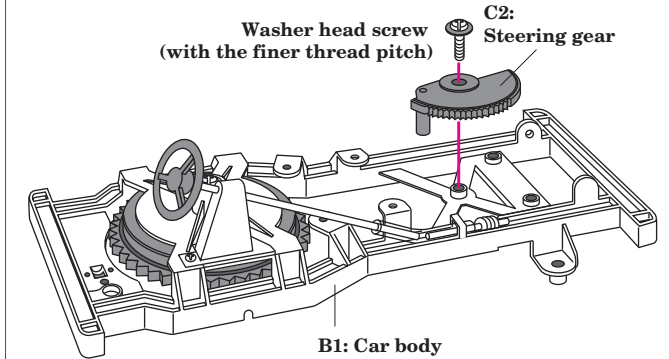
Cross-sectional diagram showing how the steering wheel is set



CAUTION: Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire. Do not allow children 15 years of age or younger to conduct the experiment without adult supervision.

Figure-(12)
Using the washer head screw (with the finer thread pitch), install the C2 steering gear in the B1 car body.

(12) Install the steering gear.



4 Assembling the Suspension

Parts to be used PARTS D

* The kit may contain more screws, etc. than actually required, for use as spares.

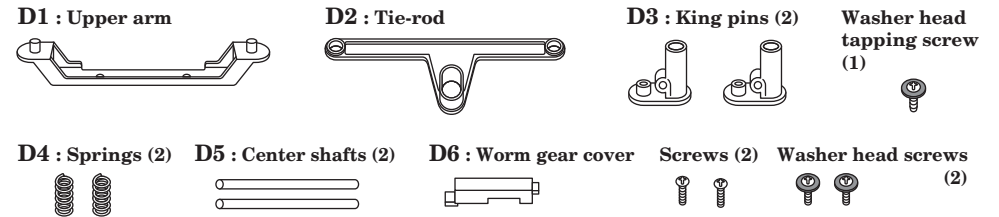


Figure-(13)
Using the washer head screws, secure the D3 king pins to the D2 tie-rod in two locations.

(13) Assemble the tie-rod.

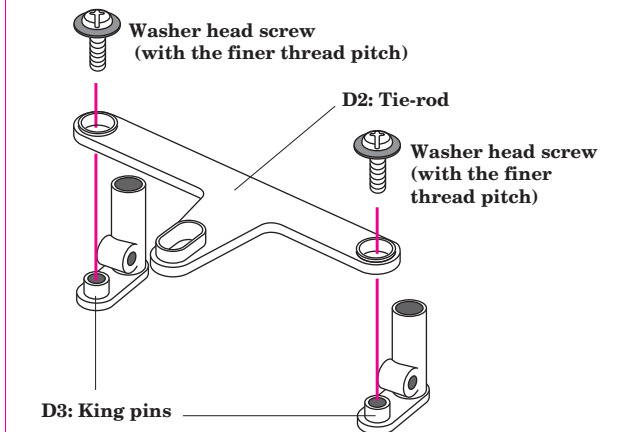


Figure-(14)
Using the washer head tapping screw, install the tie-rod assembled in Figure-(13) in the C2 steering gear.

(14) Install the tie-rod in the car body.

CAUTION
Use the screw with the coarser thread pitch.

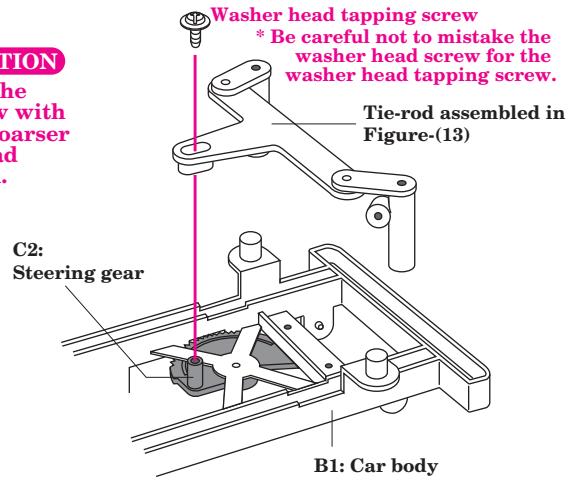
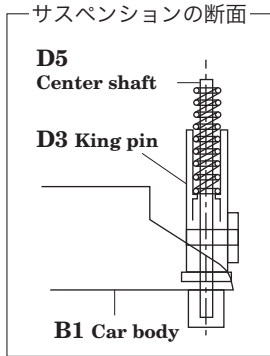
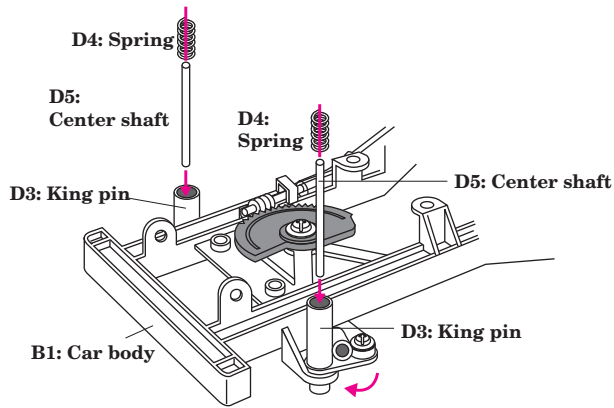


Figure-(15)
Insert the D5 center shaft through the D3 king pin all the way to the B1 car body. Then, insert the D4 spring.

(15) Assemble the king pins.



(16) Install the worm gear cover.

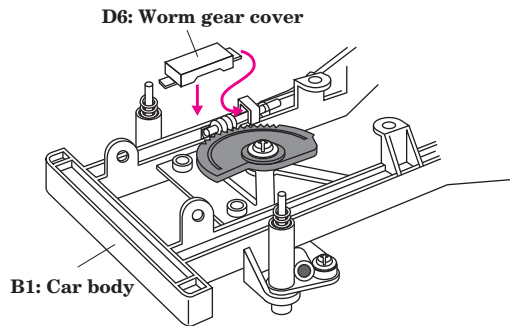
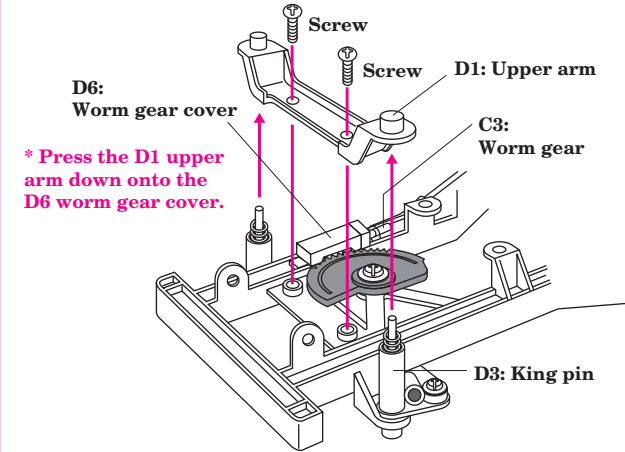


Figure-(16)
Install the D6 worm gear cover in the B1 car body.

Figure-(17)
To secure the D3 king pin, use the screws to fasten the D1 upper arm in two locations. At this point, also press the D1 upper arm down onto the D6 worm gear cover.

(17) Install the upper arm.



5 Assembling the Wheels

Parts to be used PARTS E * The kit may contain more screws, etc. than actually required, for use as spares

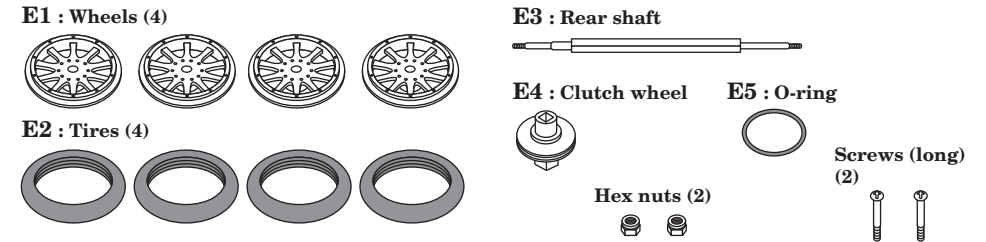
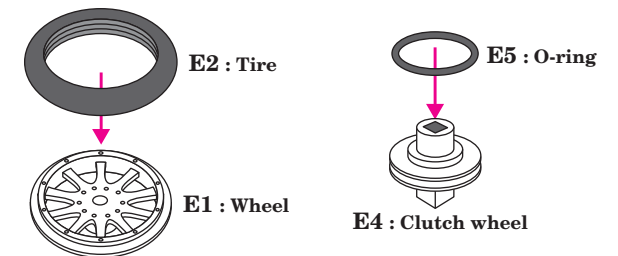


Figure-(18)
Install four E2 tires onto four E1 wheels. Install the E5 O-ring onto the E4 clutch wheel.

(18) Assemble the wheels and clutch wheels



CAUTION: Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire. Do not allow children 15 years of age or younger to conduct the experiment without adult supervision.

Figure-(19)
Using the screws (long), install the two wheels assembled in Figure-(18) onto the D3 king pins.

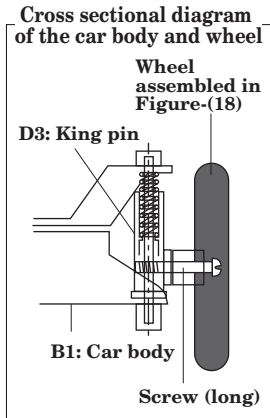
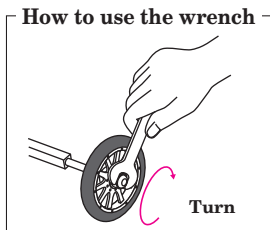
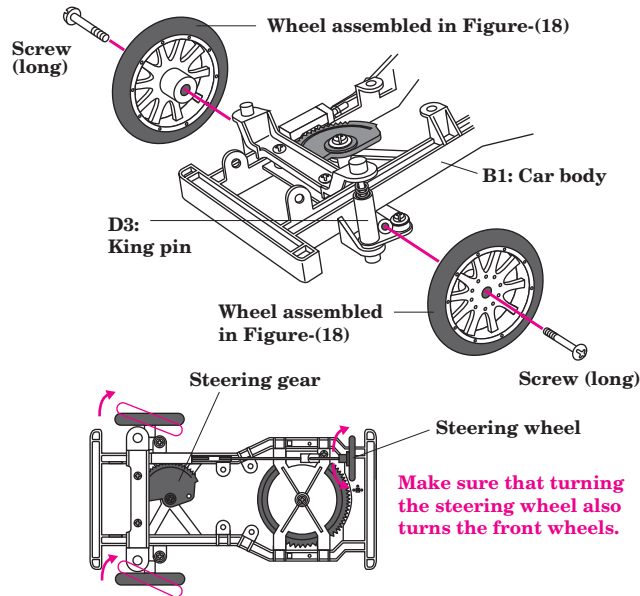


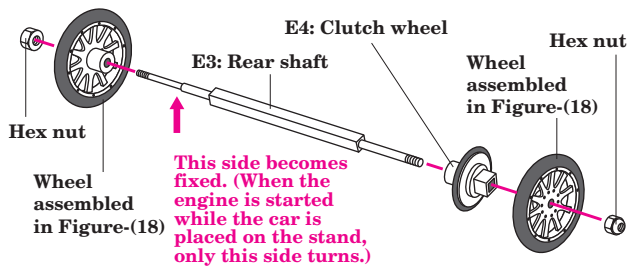
Figure-(20)
Install the hex nut, a wheel, the E4 clutch wheel, another wheel, and the hex nut, in that order onto the E3 rear shaft.



(19) Install the front wheels onto the car body.



(20) Assemble the rear wheels.



6 Assembling the Clutch and Installing the Rear Wheels

Parts to be used **PARTS F**

* The kit may contain more screws, etc. than actually required, for use as spares.

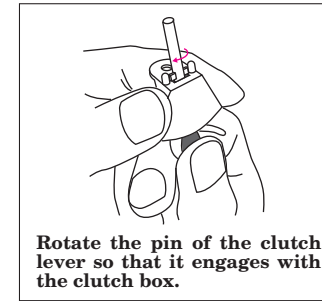
F1 : Clutch box F2 : Clutch lever F3 : Clutch guide F4 : Seat F5 : Shaft stoppers (2)



Screws (3) Washer head screw (1)



Figure-(21)
Set the F2 clutch lever in the F1 clutch box, and use a screw to install them in the B1 car body. Then, use a washer head tapping screw to install the F4 seat as well.



Cross sectional diagram of the car body and the clutch

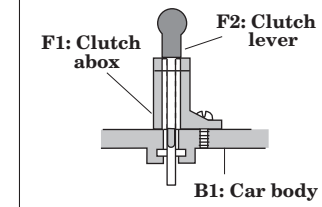
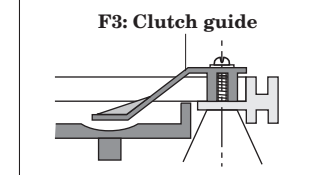
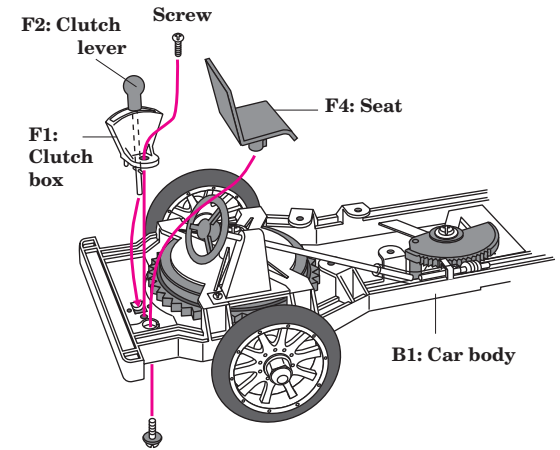


Figure-(22)
From the bottom side of the B1 car body, thread the F3 clutch guide to the tip of the F2 clutch lever. Then, use a washer head screw (with the finer thread pitch) to install the clutch guide. (Be careful not to insert the screw in the wrong hole.)

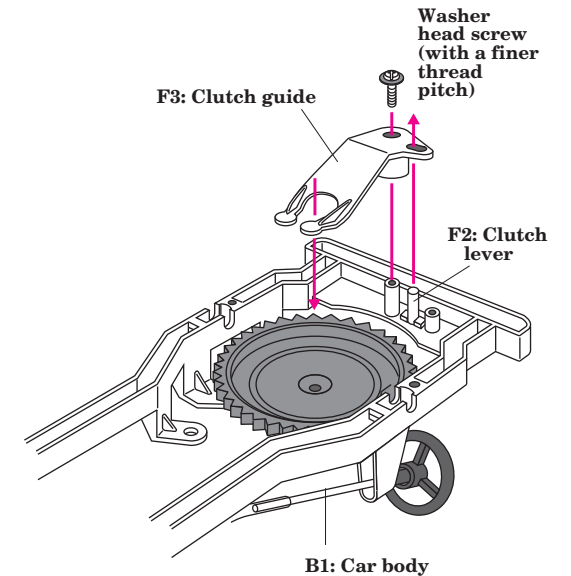
Cross sectional diagram of the set clutch



(21) Install the clutch box and seat.



(22) Install the clutch guide.



CAUTION: Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire. Do not allow children 15 years of age or younger to conduct the experiment without adult supervision.

Figure-(23)
Use the F5 shaft stoppers and screws to fasten the rear wheels assembled in Figure-(20) in two locations.
CAUTION: The rear wheels cannot be installed if their left-right orientation is wrong.

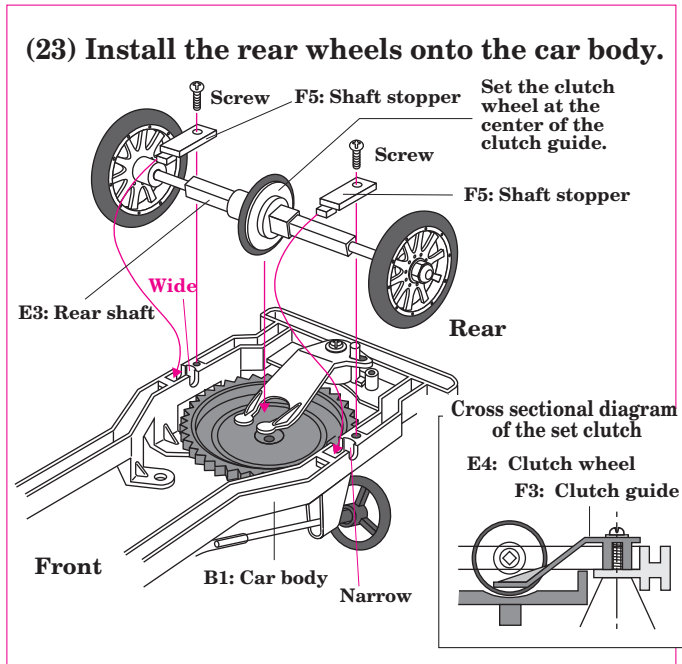
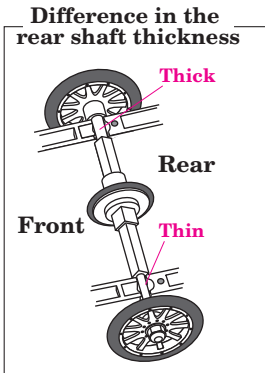
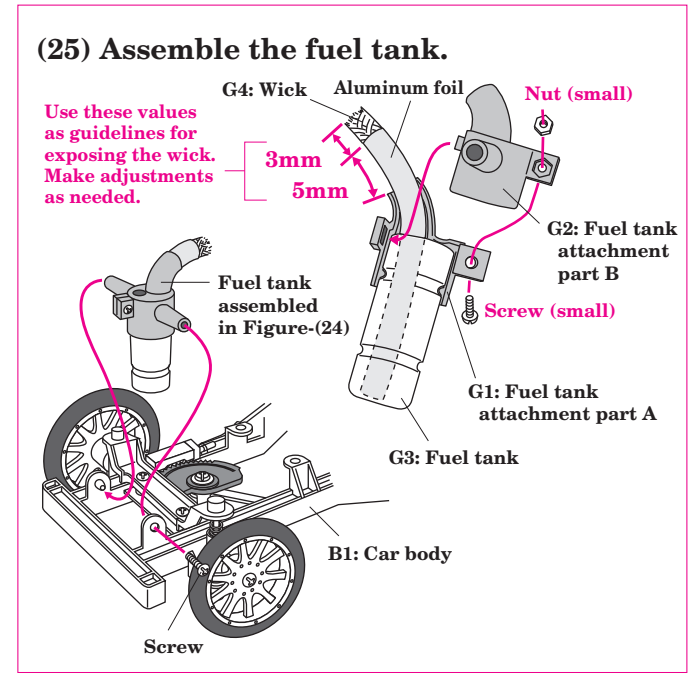


Figure-(25)
Set the G3 fuel tank and the wick made in Figure-(24) in the G1 fuel tank attachment part A, and use the screw (small) and the nut (small) to secure the G2 fuel tank attachment part B. Then, use the screw to install the fuel tank in front of the front wheels.



7 Installing the Fuel Tank

Parts to be used PARTS G * The kit may contain more screws, etc. than actually required, for use as spares.

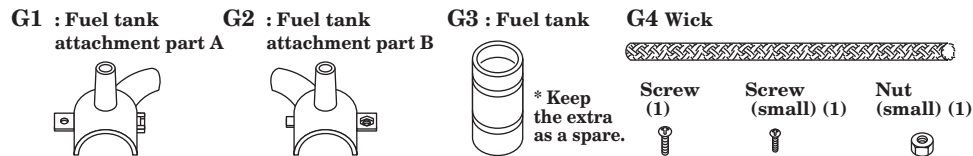
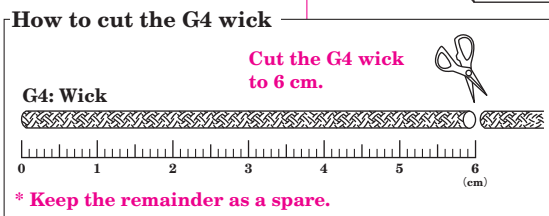
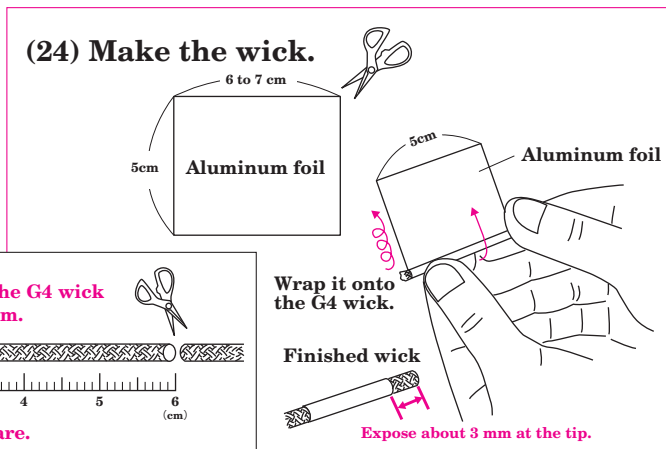


Figure-(24)
Cut the aluminum foil into a sheet measuring 5 cm x 6 to 7 cm. Wrap the cut aluminum foil onto the wick.



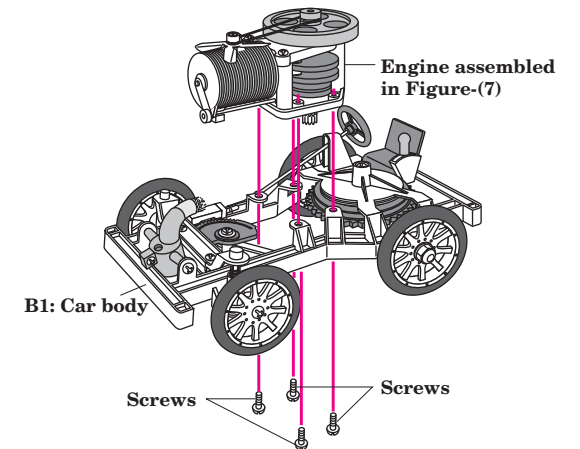
8 Installing the Engine

Parts to be used

Screws (4) * The kit may contain more screws, etc. than actually required, for use as spares.

Figure-(26)
Using the four screws, install the engine assembled in Figure-(7) in the B1 car body.

(26) Install the engine.



CAUTION: Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire. Do not allow children 15 years of age or younger to conduct the experiment without adult supervision.

9 Assembling the Stand

Parts to be used PARTS ①

* The kit may contain more screws, etc. than actually required, for use as spares.

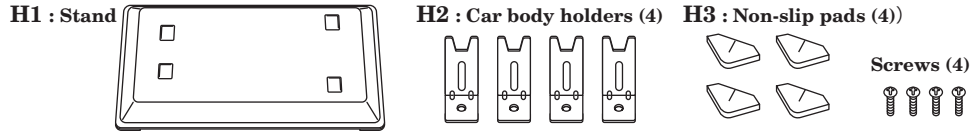
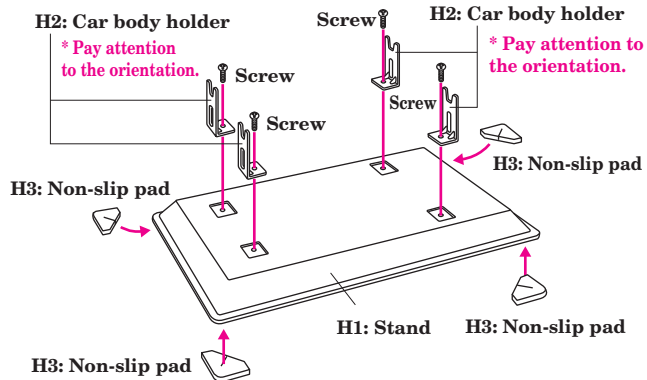
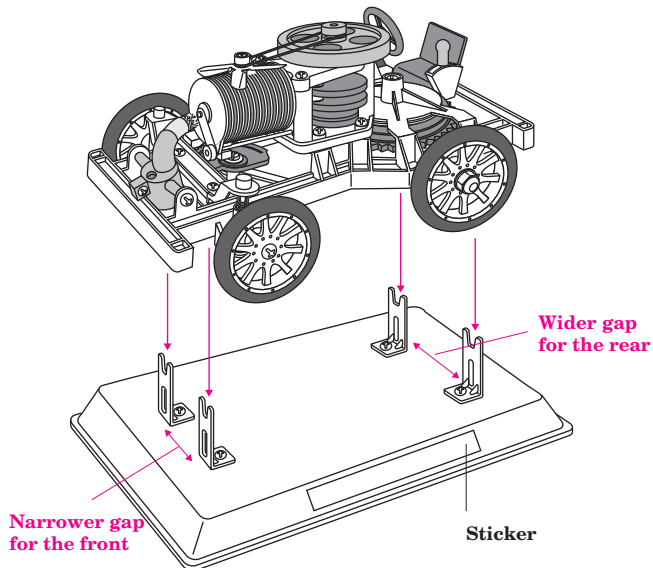


Figure-(27)
Using the screws, install the H2 car body holders onto the H1 stand, being careful about the correct orientation. Then, attach the H3 non-slip pads to the four locations on the bottom of the H1 stand.

(27) Install the car body holders in the stand.



(28) Set the car body on the stand to complete.



Peel off the protective film from the double-sided stickers and attach the pads

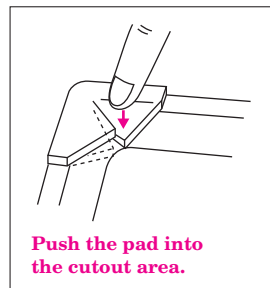
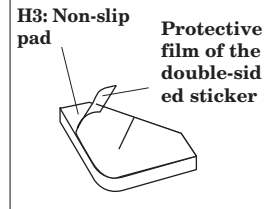


Figure-(28)
Set the assembled car body on the stand. Apply the sticker to the desired location.

10 Experiment on Starting the Engine

Figure-(29)
Make sure that the flywheel can be turned smoothly by hand in the clockwise direction viewed from above. If it resists turning, check the assembly again.

It is normal for the flywheel to resist turning when turned in the opposite direction (in the counter-clockwise direction viewed from above).

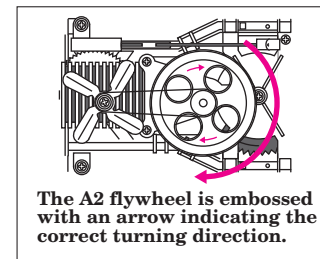


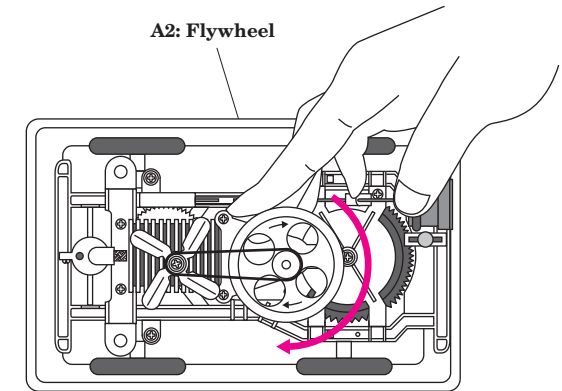
Figure-(30)
Inject the alcohol fuel into the fuel tank. (The amount that can be drawn up into the supplied pipet is about right.) Be careful not to spill any alcohol fuel when injecting it into the fuel tank. Should a spill occur, use a tissue and the like to wipe it up completely. Then, wet the tissue with water before discarding it.
* Alcohol fuel can be purchased at drugstores and the like.

Since this experiment involves the use of a flame, have a wet towel, etc. readily available for emergency use.

Wet towel

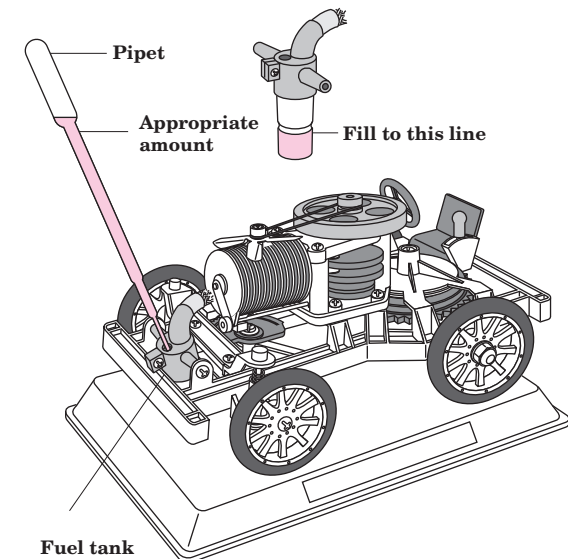


(29) Check the rotation of the flywheel.



* Turns in the clockwise direction.

(30) How to inject alcohol fuel.



CAUTION: Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire. Have a wet towel, etc. readily available for emergency use.

Figure-(31)

Make sure that the gear lever is in the neutral position. (The gear lever is nearly vertical when in the neutral position.)
If the gear lever is not in the neutral position, that is, if the gear is engaged, it will be difficult to start the engine.

Figure-(32)

Light the wick and start the engine by manually turning the flywheel in the clockwise direction viewed from above.

Since this experiment involves the use of a flame, have a wet towel, etc. readily available for emergency use.



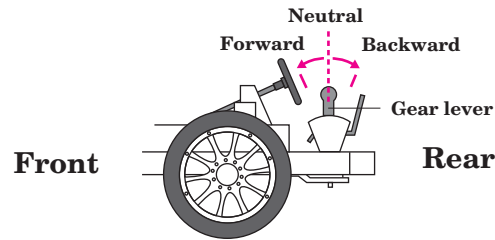
Figure-(33)

When the rotational speed has increased, move the gear lever forward or backward and check the rotational direction of the left rear wheel.
You can shift the gear between forward and backward, and also see continuous changes in the rotational speed.

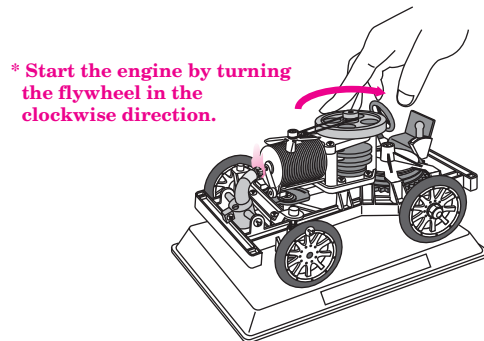
CAUTION: The experiment for rotating the rear wheel must be done while the car is mounted on the stand. While the experiment is underway, do not remove the car from the stand or turn the car upside down. Doing so will cause the alcohol fuel to spill, resulting in a fire hazard.

Furthermore, if the overall color of the flame becomes orange, this indicates that the alcohol fuel is running out and the cotton wick is beginning to burn. Immediately put out the flame, or the wick will burn up.

(31) Make sure that the gear lever is in the neutral position.

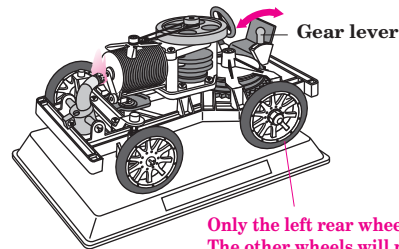


(32) Light the wick and start the engine by manually turning the flywheel.



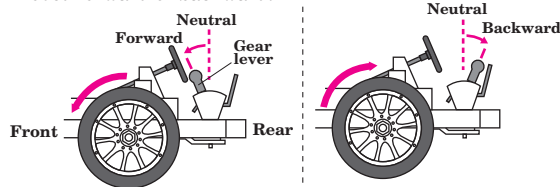
* Start the engine by turning the flywheel in the clockwise direction.

(33) Experiment to turn the left rear wheel.



Only the left rear wheel will turn. The other wheels will not turn.

The rotational direction of the wheel when the gear lever is moved forward or backward.



11 If the Engine Stalls during Starting...

Figure-(34)

If the cylinder or piston is cold, such as when the engine is to be started for the first time on a given day, the engine may stall immediately after starting. In such a case, put out the flame, wait for several tens of seconds, and then retry.

Immediately after the engine stalls for the first time, it will not be possible to turn the flywheel easily by hand.

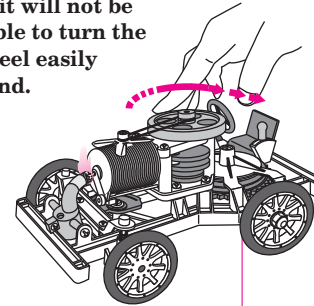


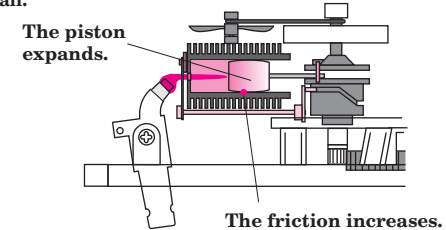
Figure-(35)

Put out the flame and let the engine cool sufficiently. After making sure that the engine is no longer hot, remove the engine part from the car body. Return to Figure-(6) on page 8, and check whether the piston falls gently from the crank unit. If not, remove crank unit A3 (top), return to Figure-(4) on page 7, and then check whether the crank unit (bottom) moves smoothly. If not, check the engine

(34) Try starting the engine four or five times.

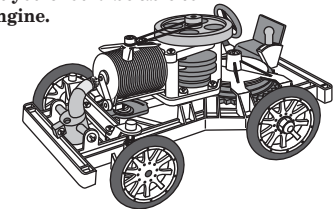
Cause of engine stall

When a high-temperature flame strikes a cold piston, the heat causes the diameter of the piston to increase slightly. As a result, the friction between the piston and the cylinder increases, leading to engine stall.

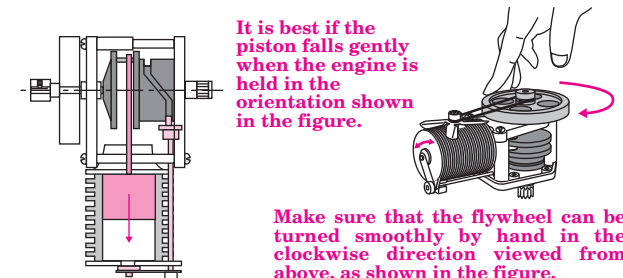


Corrective measure

Wait for several tens of seconds after putting out the flame. The heat has a chance to reach the cylinder, narrowing the difference in temperature between the cylinder and the piston. Then, the flywheel will turn smoothly again. By repeating this procedure four or five times, the difference in temperature between the piston and the cylinder will come to be even, decreasing the amount friction, with the result that you should be able to start the engine.



(35) If the engine does not start after four or five tries, remove the engine and check each part thoroughly.



It is best if the piston falls gently when the engine is held in the orientation shown in the figure.

Make sure that the flywheel can be turned smoothly by hand in the clockwise direction viewed from above, as shown in the figure.

CAUTION: Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire.

* When you turn the flywheel to start the engine, you may hear the sound of air escaping from the cylinder hole. If the engine does not start, put out the flame and allow the cylinder to cool. After making sure that the cylinder is no longer hot, flex the arm of valve rod A6 very slightly to increase the distance between the valve and the hole by just a little bit. (Increase the distance enough to produce a barely noticeable gap. Note that if the gap is too big, air will leak.) If the sound is not heard anymore, then the engine is ready and should start easily.

12 To Increase the Rotational Speed...

Figure-(36)

To increase the rotational speed, you need to adjust the positional relationship between the flame and the valve.

(Be extremely careful not to burn yourself.)

(36) To increase the rotational speed, adjust the positions of the flame and the valve.

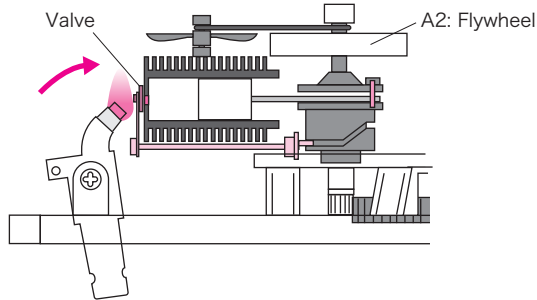


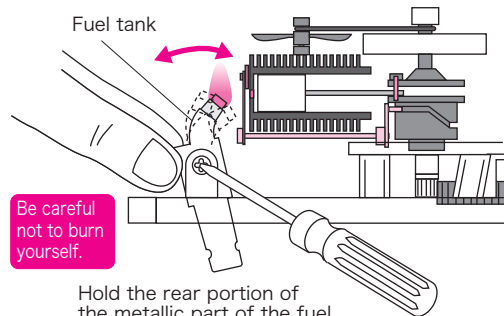
Figure-(37)

Hold the rear portion of the metallic part of the fuel tank between your fingers as shown in the figure. (The rear portion of the metallic part of the fuel tank does not usually get hot.)

Start with the flame positioned away from the valve, and then gradually move the flame closer to the valve.

While checking whether the rotational speed increases or decreases, find the position that causes the engine to reach its top speed (the flame should not be too close or too far).

(37) Adjust the position of the flame.



Hold the rear portion of the metallic part of the fuel tank between your fingers and adjust the position of the flame. If it is difficult to move the fuel tank, use a screwdriver to slightly loosen the screw.

(38) Best flame position

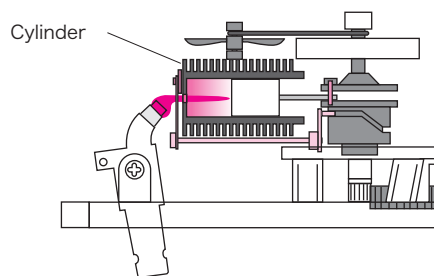


Figure-(38)

If you can see the flame being sucked into the cylinder as shown in the figure, the flame position is perfect.

CAUTION: Fire is used in the experiment. Exercise extreme care to avoid burning yourself or starting a fire. During the experiment, do not turn the car body upside down or make it stand on its end. Doing so will cause the alcohol fuel to spill, creating a fire hazard.

13 If the Engine Output Drops...

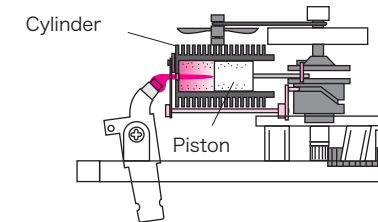
Figure-(39)

When the engine is used continuously, its output may suddenly drop in some cases. If this happens, clean the piston and cylinder.

CAUTION: Be sure to put out the flame and wait for the engine to cool down before cleaning.

(39) Clean the piston and the cylinder.

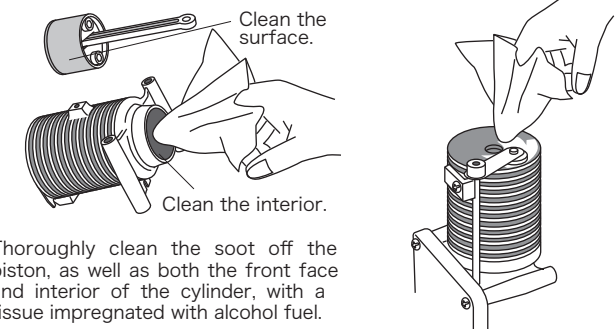
Cause of drop in output
Soot produced when the flame is sucked into the cylinder can accumulate inside, increasing the friction between the cylinder and the piston. This will result in a drop in engine output.



Cleaning method

1. Referring to Figure-(26) on page 17, remove the engine from the car body.
2. Retracing the steps in Figure-(7) on page 8, Figure-(6) on page 8, Figure-(5) on page 8, Figure-(4) on page 7, and Figure-(3) on page 7, return the cylinder and the piston to the state shown in Figure-(2) on page 6.
3. Thoroughly clean the soot off the piston, as well as both the front face and interior of the cylinder, with a tissue impregnated with alcohol fuel.

Cleaning supplies



Thoroughly clean the soot off the piston, as well as both the front face and interior of the cylinder, with a tissue impregnated with alcohol fuel.

(40) Cleaning only the front face of the cylinder

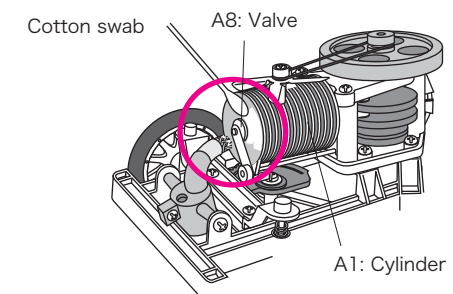


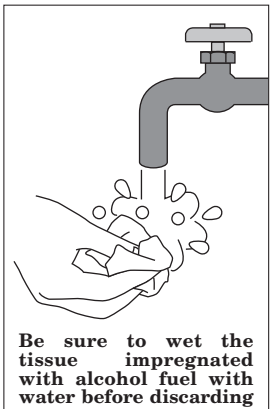
Figure-(40)

Use a cotton swab to clean off any soot accumulating on the surface where the A1 cylinder and the A8 valve make contact.

CAUTION: Be sure to put out the flame and wait for the engine to cool down before cleaning.

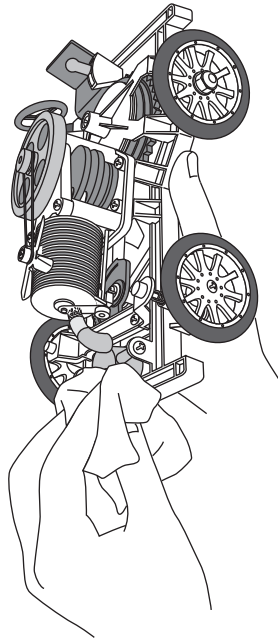
14 When You Have Finished the Experiment

Figure-(41)
When you have finished the experiment, always be sure to remove the alcohol fuel. Tilt the car body, allowing the alcohol fuel to flow out of the fuel tank and soak into the tissue. Then,



Be sure to wet the tissue impregnated with alcohol fuel with water before discarding

(41) Dispose of the alcohol fuel.



Cautions about the flame and heat

- Do not leave the engine unattended while it is still hot or the flame is lit.
- While the flame is lit, do not lift the car or its stand.

Doing so may cause the alcohol fuel to spill, creating a fire hazard.

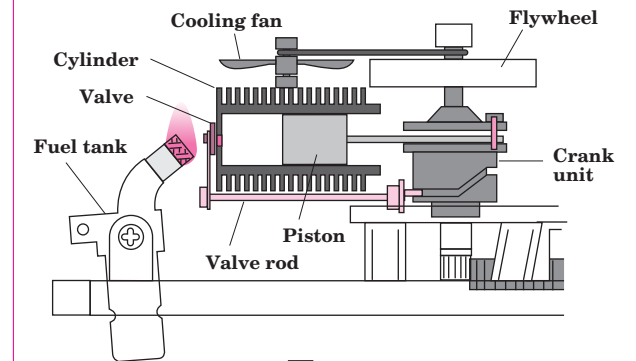
- When running the engine of the car while mounted on the stand, do not place the stand on a slippery surface.

There is a possibility that the car and its stand move.

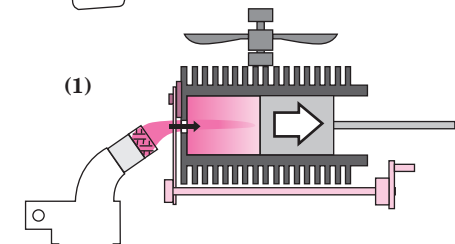
- While running the experiment, pay close attention to small children.
- After you have finished the experiment, be careful about residual heat.
- After you have finished the experiment, remove the alcohol fuel from the fuel tank. (Let the alcohol fuel soak into the tissue. Then, wet the tissue with water before discarding it.)
- After you have finished the experiment, use caution when storing the alcohol fuel. Store the alcohol fuel in a location out of the reach of small children. (Same for the product.)

Principles of the Vacuum Engine

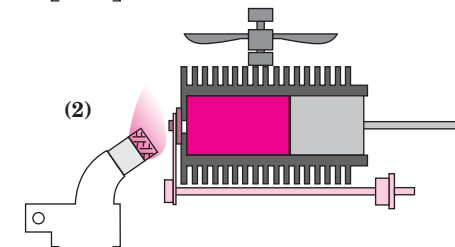
This engine is a type of external combustion engine that has an external heat source. When heated air sucked into the cylinder is cooled inside it, a near vacuum state is created, which in turn moves the piston. Furthermore, the opening/closing of the valve is synchronized with the piston by a crank mechanism. Additionally, the flywheel helps maintain stable rotation.



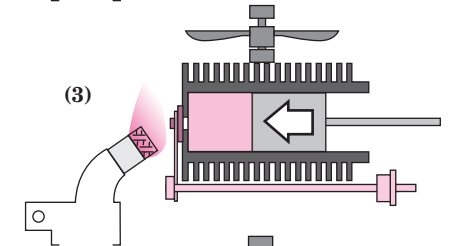
(1) The valve opens. As the crank moves toward the center, heated air is sucked into the cylinder.



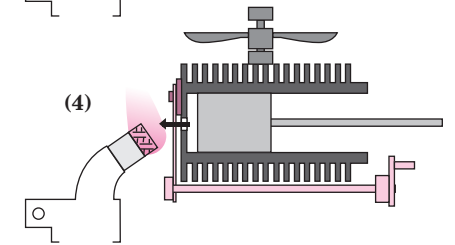
(2) When the piston moves all the way toward the crank unit (this point is called the bottom dead center), the valve closes and cooling of the air inside the cylinder begins.



(3) The cooled air contracts, creating a near vacuum state. As a result, the piston is pulled toward the valve.



(4) When the piston moves all the way toward the valve (this point is called the top dead center), the valve opens. The contracted air inside the cylinder is expelled and at the same time the engine



Q: When I run the experiment with the car mounted on the stand, only one of the rear wheels turns.

A: The car in the kit is designed to transmit the rotational power of the engine to only one of the rear wheels. If both wheels were fixed, the difference between the turning radii of the inner and outer wheels during cornering would place a large strain on the drivetrain. In an actual car, a mechanism called a "differential gear" is used to take up the difference in the rotational speeds of the right and left wheels. In the kit, the load increase that would be caused by a difference in the rotational speeds is avoided by keeping one of the wheels free. Therefore, when the car is mounted on the stand, only one of the rear wheels turns.

Q: Where can I obtain alcohol fuel?

A: Ask for alcohol fuel at a drugstore.

Q: I spilled the fuel.

A: Wipe it up with tissue paper or the like. Then, wet the tissue with water before discarding it. If you are planning to continue with the experiment, make sure any spilled alcohol has dried completely before lighting a flame.

Q: The rotation is slow.

A: Either the position of the flame is not the most appropriate, or the movements of the piston or gear may be too slow. Read pages 22 to 23 of this manual.

Q: I cannot run the engine continuously.

A: The flame may be extinguished in some cases by the exhaust coming out of the hole on the front of the cylinder. In such a case, move the flame slightly away from the valve.

Q: The engine ran fine the first time, but it would not start again when I tried to start it a second time immediately afterwards.

A: If there is dew condensation on the piston or inside the cylinder, it may be difficult to start the engine. Let the engine sit for a while and then try again.

Q: The wick is getting shorter.

A: The wick is 100% cotton, so when the alcohol fuel burns up, the wick starts burning. Be sure to always put out the flame before the alcohol fuel runs out. Just before the alcohol runs out, the flame will become completely orange and there will be a lot of soot.

Q: Can I oil the piston and cylinder?

A: No. Do not oil the piston or cylinder because a special treatment has been applied to them.

CAUTION! (Be sure to read this section.)

● When installing seat F4 in Figure-(21) on page 15, use the screw (tapping screw without washer) included in the same bag as the seat.

● If the engine does not start:

1. Refer to page 21 and try starting the engine four or five times. When doing so, refer to page 22 and turn the flywheel while adjusting the position of the flame relative to the valve (be careful not to burn yourself).

2. Make sure the gear lever is in the neutral position. If the gear is engaged, the resulting load may prevent the engine from starting.

3. Remove the A10 fan belt, which connects the A2 flywheel to the A7 cooling fan. If the A10 fan belt is connected, the resulting load may prevent the engine from starting. Once the engine output stabilizes, reconnect the A10 fan belt.

4. Slightly loosen the washer head tapping screw installed in Figure-(9) on page 9. This will remove the load and may help the engine start easily.

5. Remove the engine only, and slightly loosen the two screws installed in Figure-(3) on page 7, as well as the three screws installed in Figure-(5) on page 8 (remove the flywheel). This will position the piston in the A5 piston unit parallel to the A4 crank unit (bottom) and may help the engine start more easily.

● The standard rotational speed is around two revolutions per second. To increase the rotational speed, see pages 22 to 23.

● Once the engine has started, put out the flame after about 2 minutes. If the engine overheats, its output will drop. If the engine output drops, cool the cylinder first and then restart the engine.