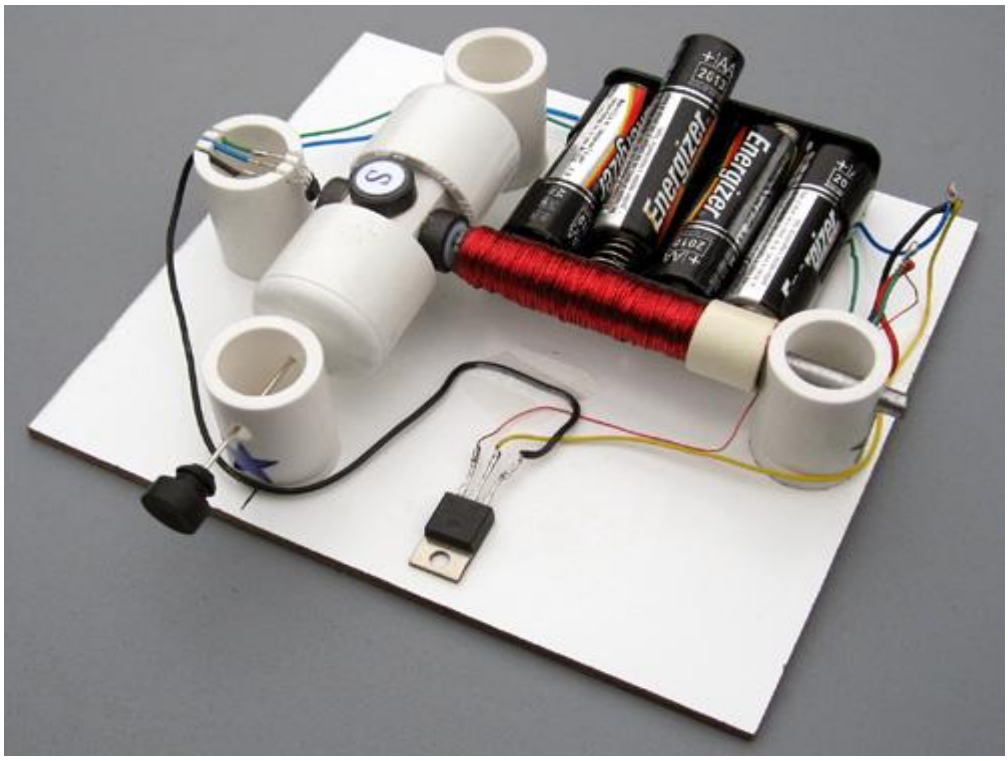
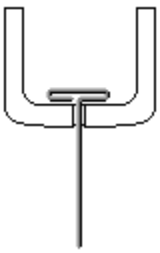
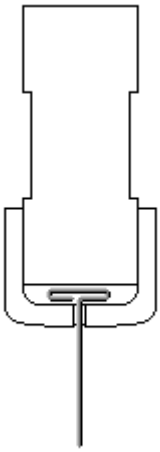
Assembly Instructions: Kit #6



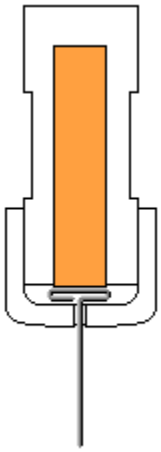
1. Insert the T-pin into one of the caps.



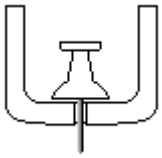
2. Insert the rotor core into the same cap as shown below. Apply some pressure to push the rotor core approximately 1/2" (10-12 mm) into the cap.



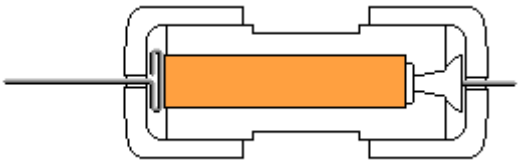
3. Put in the wooden insert.



4. Insert the pushpin into the other cap until it is fully seated and the end of the pushpin sticks out approximately 1/4" (6-7 mm). You may need to push it hard.

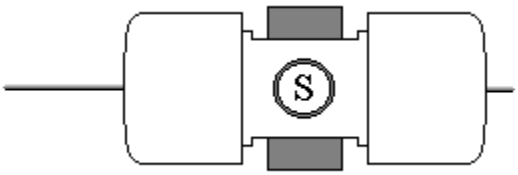


5. Put everything together as shown below. Push the caps towards each other until they cannot move any more. The T-pin must be secured firmly. This process may require some strength. Be careful not to bend the T-pin or poke yourself.

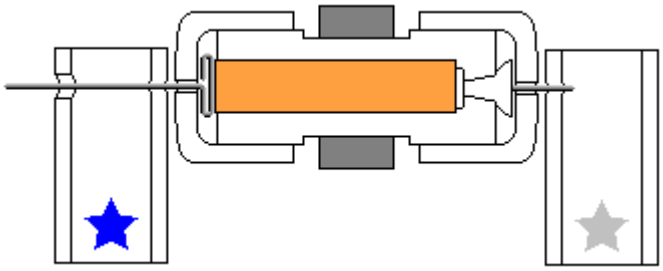


6. Glue the magnets to the flat surfaces of the rotor core with the letter 'S' facing outside (or a dimple facing inside). Your kit includes 4 magnets. If you want to try 2 magnets first, glue them to the opposite sides. Straighten the T-pin if necessary. You can check it by spinning the rotor between your thumb and index finger. Again, be very careful.

   All kits have magnets with one of the poles marked with either a letter 'S' on the South pole or a dimple on the North pole. If you want South side to look better, you may cut out the white glossy round labels that are provided and paste them. You may do it before attaching the magnets to the rotor. It is recommended to use regular white glue or a glue stick on the labels for better results.

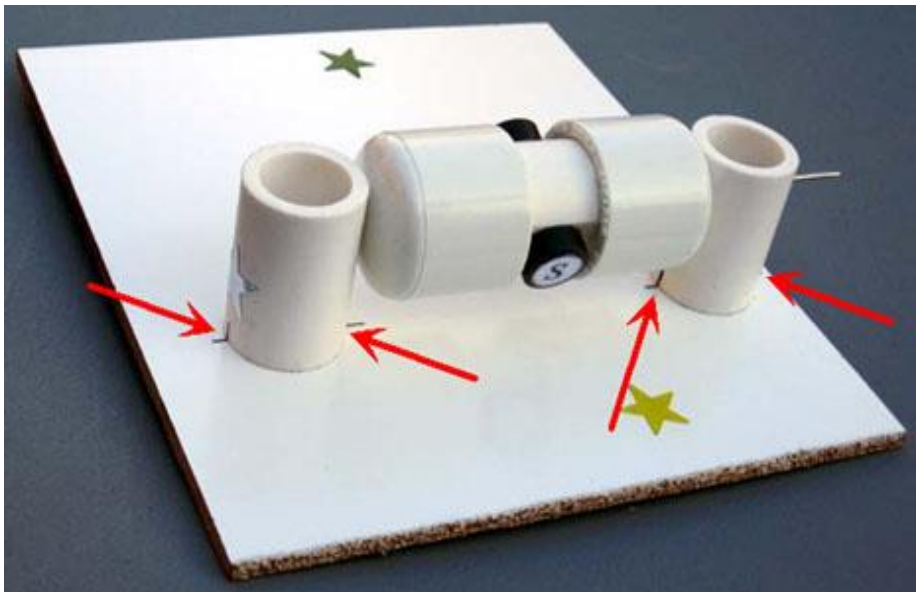


7. Insert the rotor into the stands marked with blue and silver stars as shown below. Hold the stands and test to see if rotor spins freely. Make final adjustments to the T-pin if necessary.

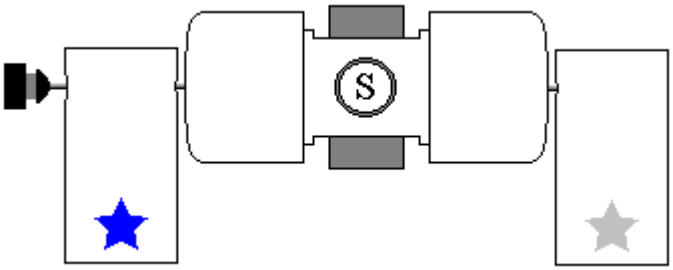


8. IMPORTANT: *If you plan to attach propeller to your motor try to glue the stand with the blue star as close to the edge as possible. You may need to shift the whole rotor assembly.*

   Glue the stand with the silver star to the board. Try to cover the corresponding star completely. Align the marks on the stand with the line on the board as shown below. Note that the star's position and the marks are approximate, sometimes you need to move the stands slightly to achieve the lowest friction. Keep in mind that super glue bonds instantly, so try to be as accurate as possible in these procedures.

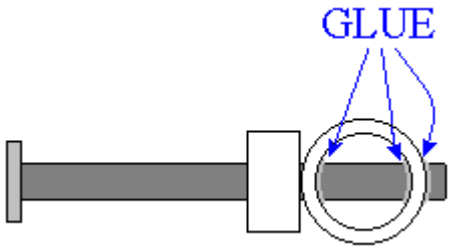


9. Insert the rotor into the stand marked with the blue star. Glue it to the board the same way as the first stand. Leave a gap of about 1/16" (1/32", or 0.8 mm on each side) between the rotor and the stands. Test again to see if the rotor spins freely. At this time, or later, you may take the rubber plug and fix it as shown below. You can glue different things to the outer flat surface of the plug. Try to be accurate, redo this step if necessary.

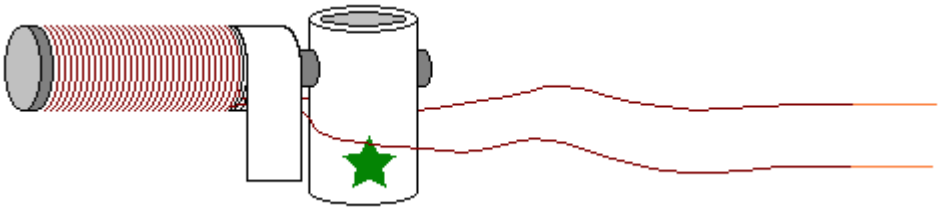


10. If you purchased the wire comparison kit, instead of steps 10-12 for this kit, follow instructions for wire comparison kit. After that, please, continue the assembly instructions from step 13.

    Otherwise, insert the nail into the stand with the green star. If it is loose you may apply glue as shown below.

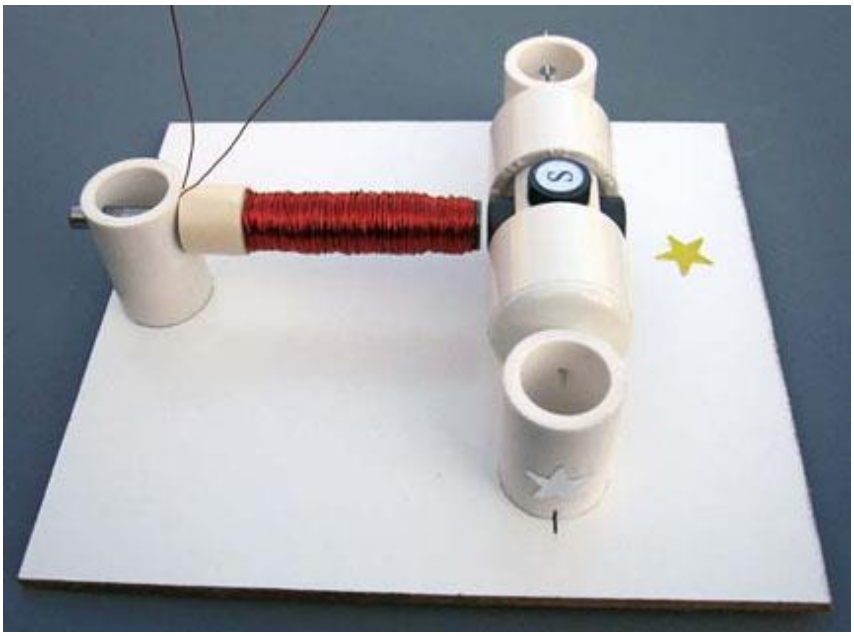


11. All wire on the spool should be used to wrap around the area between the tape and the head of the nail.
    - Tape one end of wire leaving about 6" (15 cm) open. You may use the tape that is already on the nail.
    - Wind all the wire in one rotational direction (either clockwise or counterclockwise) moving back and forth along the nail. Try to be as accurate as possible. Do not let the wire slide off the end of the electromagnet.
    - Tape the second end of the wire using the same tape. Both open ends of wire should be about 6" (15 cm) long.
    - Clean about 3/8" (10 mm) of the wire tips with fine sandpaper (included) or a sharp knife to remove the insulation.



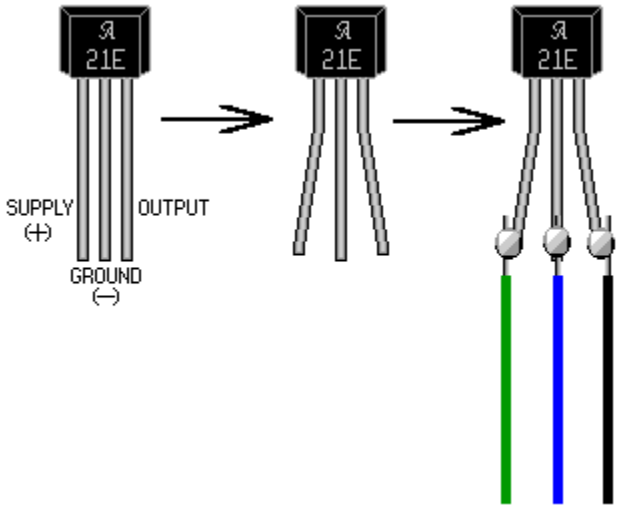
Test the electromagnet! Connect one wire to "+" and another wire to "-" of the battery. If electromagnet is assembled correctly the head of the nail should attract metal objects such as paper clips, small nails, knife blade, etc.

12. Glue the electromagnet to the board as shown below. Turn the rotor slowly to see if the magnets hit the electromagnet. If one or more do, move the electromagnet back until there is a 1/16" (1.5 mm) gap between the electromagnet and the closest magnet on the rotor.

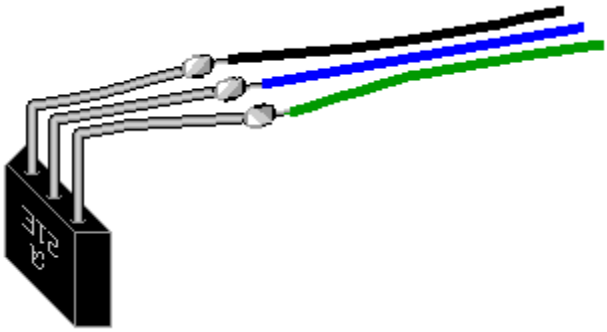


13. Bend the leads of the Hall Effect switch as shown below. If your kit includes 1 large piece of hook-up wire, cut it into 4 pieces of equal length. Strip about 3/8" (10 mm) of insulation on each end of these wire pieces using a sharp knife. Solder three wire pieces to the Hall Effect switch. If you did not use a soldering iron before it is a good idea to practice on soldering two pieces of wire to each other. See the Links page at our web site for tips on soldering.

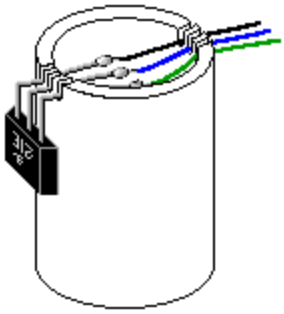
    IMPORTANT: Do not overheat the Hall Effect switch when you solder it. The soldering iron heat may destroy this sensitive device. If you were unable to attach the wire in 3 seconds, let the Hall Effect IC cool off, and then try it again. Only solder one lead at a time and allow the device to cool before soldering the next connection. Use the same precautions when soldering the transistor.



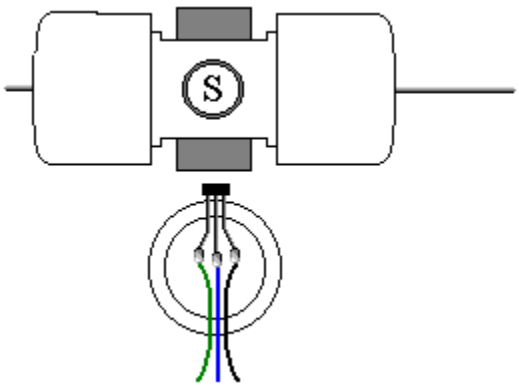
14. Bend the Hall Effect switch leads 90 degrees with branded side facing outside:



15. Insert the Hall Effect switch into its stand. Make sure that the leads of the Hall effect IC do not touch each other. You may push the wires in using a flat screwdriver.

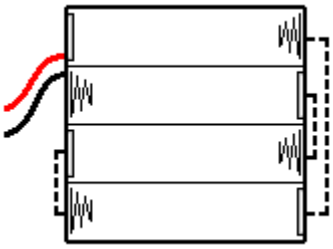


16. Glue the Hall Effect switch holder to the board. The Hall Effect switch should be located in front of the magnets at the distance of about 1/8" (3 mm) or closer. Check the rotation of the rotor to make sure that the magnets do not hit the Hall Effect switch.

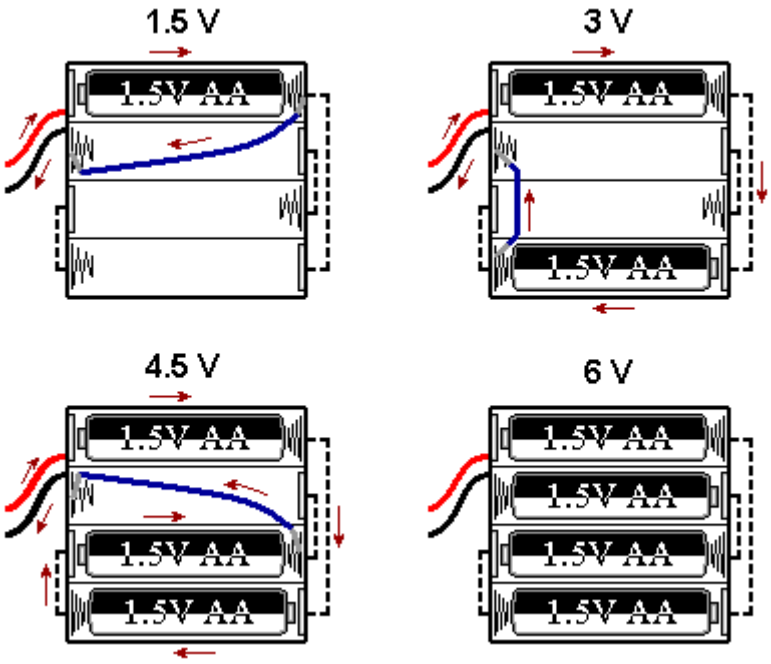


17. Attach the battery holder to the board. The battery holder allows you to experiment with 4 different voltage settings (1.5, 3, 4.5, and 6 V DC). You will need 4 AA size batteries.

    To understand how the jumper wire works let's take a look at the connections inside a typical battery holder:



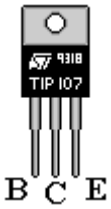
    The following diagram shows how to get 1.5, 3, 4.5, and 6 Volts using 1, 2, 3, or 4 batteries and a jumper wire shown in blue color. Arrows show the current flow for 1.5, 3, and 4.5 Volts settings. Could you trace the current when all 4 batteries are inserted (there is no jumper wire in this case)?



    Inspect your battery holder – it may have different connections inside. In this case you can still use the jumper wire in the same manner to get all 4 voltages, but you will need to find appropriate connection points for each voltage setting.

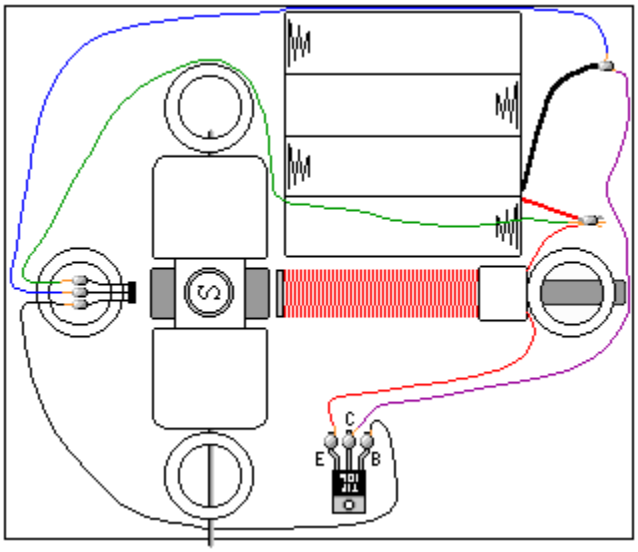
Insert bare ends of the jumper wire between the spring and plastic case to make a good contact and hold them in place. This is how the jumper wire is actually used for 3 Volts experiments (one end is disconnected and may serve as on/off switch):

18. Locate the base (B), collector (C) and emitter (E) leads on the transistor:



19. Follow these steps using the wiring diagram for Kit #6 on the next page. You may trim the wires if necessary.

    - If you do not plan to use a heat sink you may glue the transistor with branded side up to the board using a small drop of super glue.
    - Solder one end of the remaining piece of hook-up wire to the collector of the transistor.
    - Solder the other end of that wire, the negative (black) wire of the battery holder, and the wire that is connected to "ground" lead of the Hall effect switch together. It is easier to solder this connection if you twist the wires together first.
    - Solder the wire from the "output" lead of the Hall effect switch to the base of the transistor.
    - Solder the "supply" lead from the Hall effect switch to the positive (red) battery holder wire.
    - Before soldering the electromagnet wires insert the batteries into the battery holder. Briefly connect one of the electromagnet wires to the positive (red) battery holder wire and the other electromagnet wire to the emitter as shown below. If the electromagnet doesn't repel the permanent magnets away, switch the wires.
    - If the motor works, remove the batteries and solder these wires.
    - You may tape the wires to the board using scotch tape.



Start with 3 V. If the motor does not work, increase voltage to 4.5 V. If it still doesn't work, ensure that the rotor can rotate freely and check all the connections – it is important to clean the insulation thoroughly before soldering. Make sure the batteries are fresh and connected properly. If the motor still does not work – check Troubleshooting section of our web site.

CAUTION: Do not leave the motor connected to the batteries if the rotor is stalled. High current through the transistor will make it very hot. It may burn your fingers if you touch it and eventually may destroy the transistor.