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How to Make a Simple Motor . . . That Works!

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HOW TO MAKE A SIMPLE DC MOTOR ... THAT WORKS!

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Take a spin with this homemade motor. Using readily available materials, students can truly get a feel for the link between electricity and magnetism with this lively gadget.

Development

The following motor design grew out of experimentaton with various models described in popular science reference materials. Favorable characteristics of these models have been combined with several of the author's original features to increase motor durability and reliability. Particular attention has been given to three motor parts: 1) the brushes, 2) commutator, and 3) field magnets. (Fig. 1).

The brushes must maintain light but constant contact with the commutator. Metal from an evaporated milk can or other thin metal provides the springy tension required.

Narrow metal strips instead of copper wire are used for the commutator so the armature can spin freely. Bared ends of the armature wire could be used in making the commutator, but are more bulky and easily bend out of alignment.

Permanent magnets placed on inverted spice cans become movable field magnets. Precise adjustment of magnet position is, therefore, possible for optimum performance.

Classroom Usage

Students in primary grades (1-3) and above can have fun and learn some principles of electric motors by operating this device. It is safe to run and will not produce a shock. Students should be encouraged to actively rearrange the magnets and wires and observe the results. Even a "dead" motor that requires trouble shooting yields valuable problem-solving experiences.

Depending on the maturity of the class, the teacher or supervisor may choose to build the motor completely, or leave final assembly and fine tuning to the students. In the higher grades, the motor is well suited for an individual project needing little teacher supervision.

Regardless of how the motor is used, whether as a classroom learning device or an individual home-built project, it is bound to "stir" the minds of all who come near.

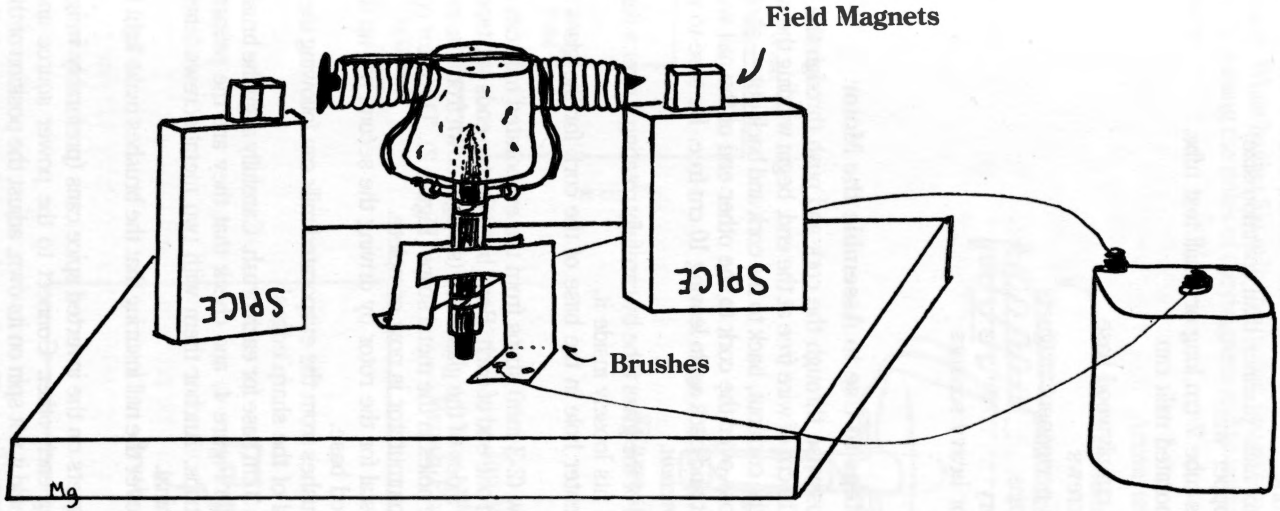

Figure 1

Materials Needed for Construction

- one large cork
- two #16 box nails (thinner than common size)
- insulated copper wire
- hollow glass tube 7 cm long or small test tube
- empty evaporated milk can
- tape
- 22 cm × 22 cm plywood base
- six metal screws
- two or four permanent magnets
- two spice cans
- 6-bolt battery
- tin shears or heavy scissors
- wire cutter

Steps to Use to Assemble the Motor

1) Drill a hole crosswise through the cork and push through the #16 nail.

2) Leaving about 10 cm of wire free at the end, begin winding the wire around the nail. Wind from the cork out, back to the cork and back out — about 50 turns altogether. Then cross over the cork to the other end of the nail winding back toward the cork, out and back again leaving 10 cm free. Be sure to wind all the wire *in the same direction.*

3) Seal off the end of the glass tube by carefully rotating it over a flame. Check that the second nail fits loosely inside it.

4) Carve out a center hole in the base of the cork for the glass tube to be inserted snugly.

5) Cut two narrow (2-3 mm) strips from the evaporated milk can 5 cm long. Pierce a small hole in one end of each. Bend back the top ends and tape the strips securely to opposite sides of the glass tube (straight down from the nail). Fasten the wire through the holes in the metal strips (Figure 2). The rotor consisting of the armature and commutator is now complete.

6) Build the pedestal for the rotor by driving the second nail up through the center of the plywood base.

7) Cut the two brushes from the evaporated milk can following the pattern in Figure 3. Be careful of the sharp edges!

8) Bend forward a 3 cm base for each brush. Carefully align the brushes across from each other as in Figure 4, and check that they are the proper height to contact the metal strips. Anchor them with two metal screws leaving a third screw up for a terminal.

9) Slide the rotor over the nail insuring that the brushes make light but certain contact.

10) Place the magnets on the inverted spice cans (preferably weighted) with opposite poles facing each other. Connect to the power source and give the armature a spin. Should it not spin on its own, adjust the position of the magnets and the tension of the brushes. The glass tube can also be rotated slightly inside the cork for possible improvement.

Note: You may want to glue the metal strips to the glass tube and also the tube inside the cork for a more permanent alignment.

Exploration: While having fun with the motor, you may want to determine the effect of: a) reversing the poles of the magnets and b) switching the wires to the power source.

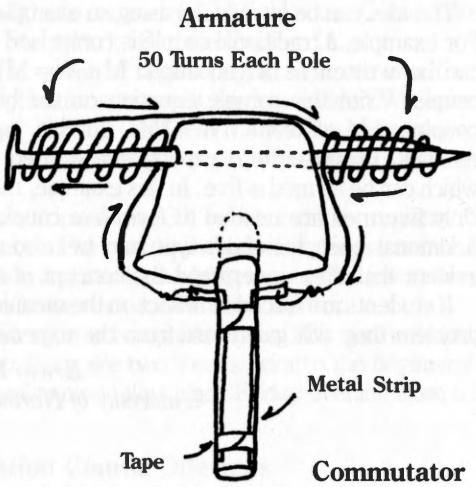

Figure 2

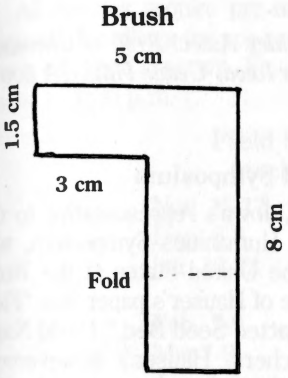

Figure 3

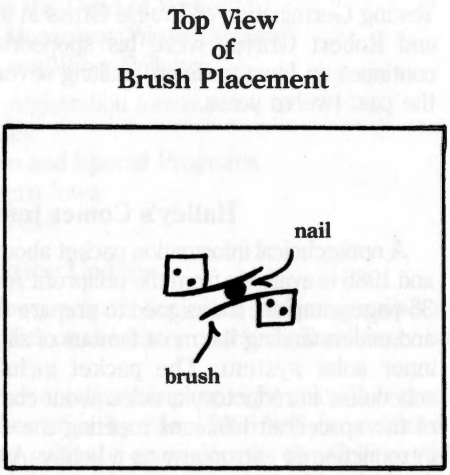

Figure 4