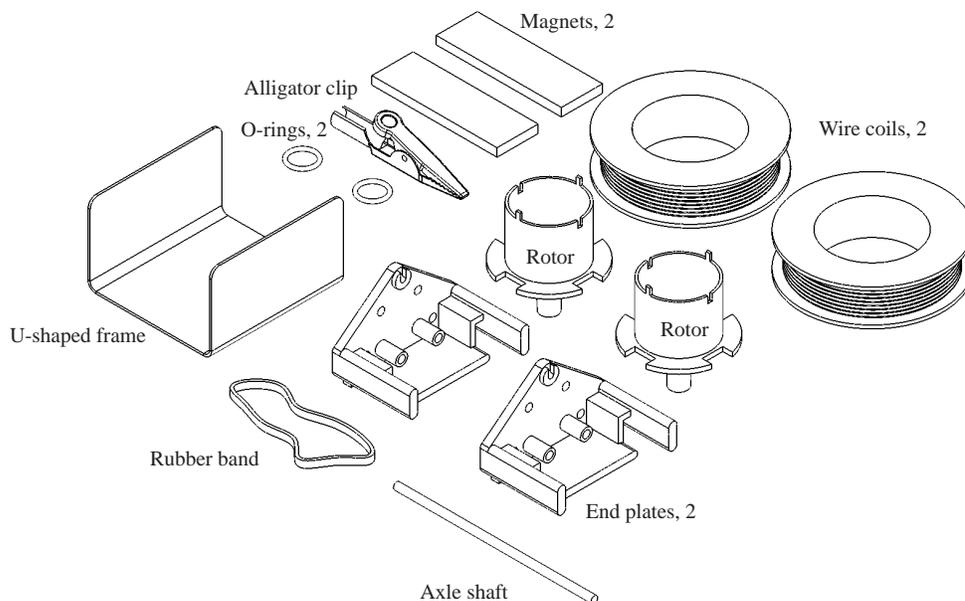
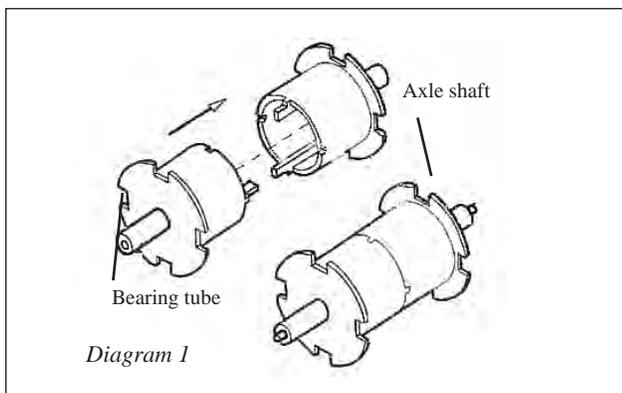


615-4710 (10-130) Neodymium Motor Kit

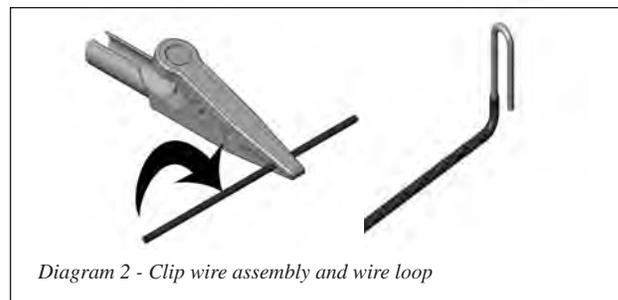


Assembly Procedure:

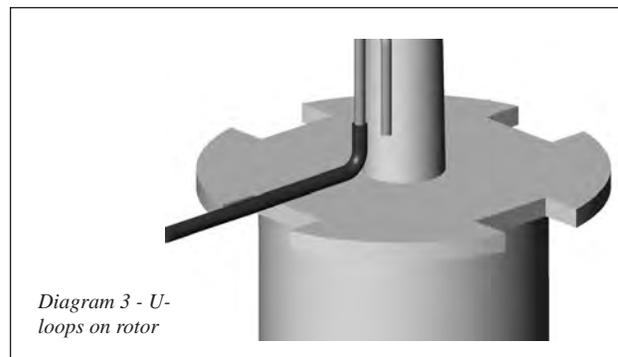
- 1 Align and assemble the two rotor/ commutator halves to make one unit. Push the two halves together until they are fully seated.



- 2 Insert the steel axle shaft through the center hole of the rotor/ commutator assembly. (*Diagram 1*)
- 3 Clip the supplied alligator clip to the free end of one of the wires from either spool of wire. Spin the clip several times to cut the insulation completely. Strip the insulation from the end of the wire. Form this stripped portion into a small U-shaped loop. (*Diagram 2*)



- 4 Hold this loop against the small diameter of the rotor/commutator assembly (this small diameter will become the commutator) and begin to tightly wrap the wire through the slots and around the rotor (the large diameter). (*Diagram 3*)



- 5 Wind 10 complete revolutions of wire around the rotor **very tightly!**
- 6 Winding more than 10 complete revolutions of wire around the rotor may cause interference (rubbing) between wire and magnets when the motor is fully assembled. If this happens, the rotor/commutator will not spin freely and the motor will not function properly.
- 7 The final winding should stop at the same end as the first stripped loop of wire.
- 8 Making sure to leave enough wire to form a second loop to place against the commutator, cut the wire, strip 25mm (1") off its second end and form into a second loop.
- 9 Align these stripped loops of wire on opposite sides of the small diameter (commutator). (*Diagram 4*)

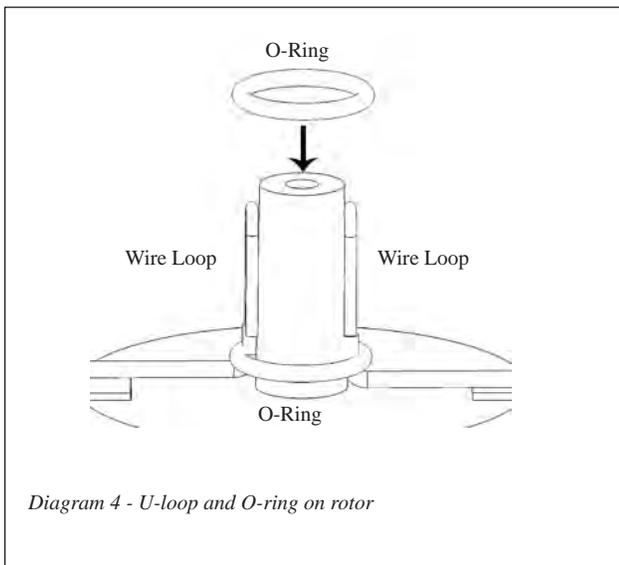


Diagram 4 - U-loop and O-ring on rotor

- 10 The small black O-rings are used to hold these wire loops in place.
- 11 Wrap one O-ring over the wire loops and the small plastic shaft (commutator), seating it as far down the shaft as possible.
- 12 Wrap the second O-ring over the wire loops and the small plastic shaft, but keep it as close to the end of the shaft as possible. This will leave a gap for the brushes to ride in. (*Diagram 5*)

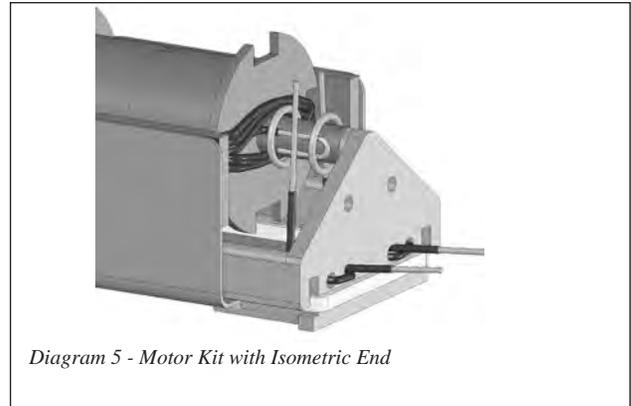
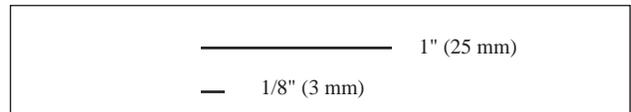


Diagram 5 - Motor Kit with Isometric End

- 13 Cut one piece, about 8" long, of both red and blue wires to form the two brush wires, using the template below as a guide.



- 14 Using the alligator clip, strip 25mm (1") off the ends of the brush wires to make contact with the commutator and battery
- 15 Locate the black plastic end plates. There are four (4) holes along the bottom of each end plate. Only one end plate has wires fed through these holes.
- 16 Feed the stripped end of one wire through one of the inner holes near the bottom of the end plate from the outside (flat surface) toward the inside, through the tube. Feed only the stripped portion of the wire through the hole. Take the other end of the same wire and feed it through the hole closest to it, again from the outside toward the inside. Feed this same end back through the tube where the first wire was fed (now from inside to outside), creating a loop. (*Diagram 6.*) Pull the wire's long free end tight as this will help keep the brushes in place once they are aligned.

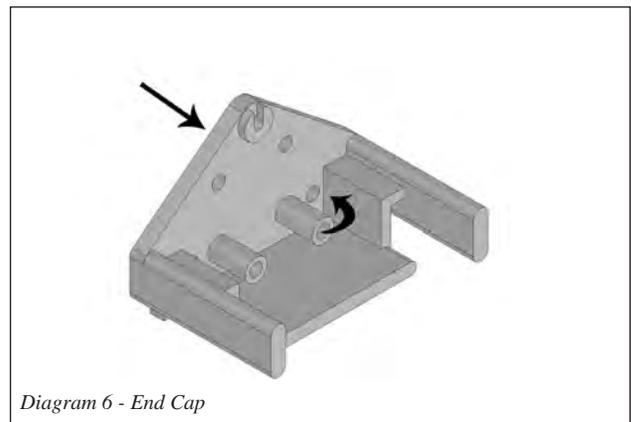


Diagram 6 - End Cap

17 You may wish to repeat this procedure one more time in order to truly lock the brush into place. However, it will be difficult to feed three strands of wires through one hole.

18 Repeat for the other set of two (2) holes using the second piece of cut and stripped wire.

19 Align brushes so they are vertical and parallel to each other, approximately 3mm (1/8") apart. (*Diagram 7*)

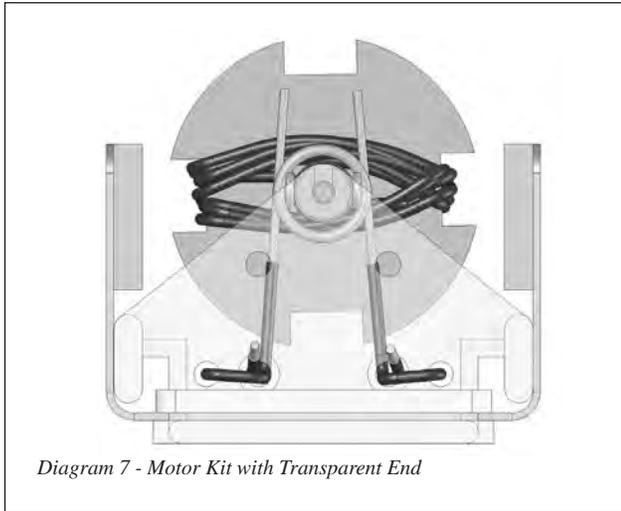


Diagram 7 - Motor Kit with Transparent End

20 Loop one elastic band through the slots near the bottom and around the end of one of the end plates. Loop this same band similarly around the other end plate's end. (*Diagram 8*)

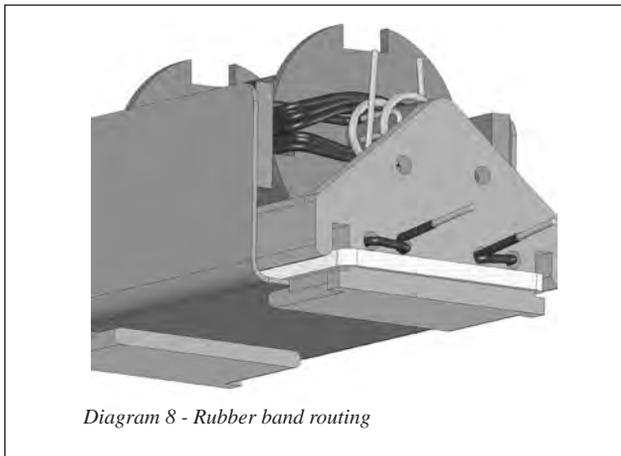


Diagram 8 - Rubber band routing

21 Assemble the two end plates onto the ends of the steel "U" frame by sliding them into place. Note how the U-frame slides into the end plate.

22 Put magnets onto the "U" frame making sure opposite poles are facing each other (magnet poles are colored - North is red).

23 With the "U" frame and end plates assembled, pull one of the end plates out just enough to insert the rotor/commutator assembly. The steel axle shaft should rest in the "U" shaped holder on each end plate and the stripped loops/O-ring portion, which forms the commutator, should be at the same end as the brushes.

24 Check to make sure the rotor will spin freely and that the brushes make contact with the commutator portion where the stripped wire loops are. Adjust as necessary.

25 Connect a AA battery. Hold the ends of the AA battery on the two free stripped wires that protrude from the end cap. (*Diagram 9.*) The rotor may need to be spun by hand at first to get it to start spinning.



Diagram 9 - Motor Kit with Battery

26 Upon complete assembly of this kit, you will have extra wire wrapped around two plastic rings (spools, extra elastic bands and possibly extra O-rings).

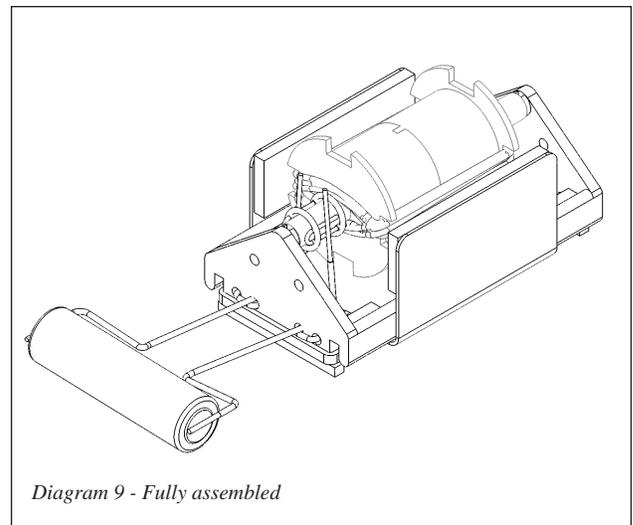


Diagram 9 - Fully assembled

Theory:

Every magnet has two poles - **north**, or *positive*, and **south** or *negative*. "Like" poles repel each other, whereas "unlike" poles attract. One north pole repels another north and attracts a South.

The attracting and repelling of the magnets causes the motor to run. The field poles become an electromagnet when an electric current flows through the wire coil around them. The armature becomes an electromagnet when an electric current passes through its wire coil. The armature, however, produces a reversing magnetic field while the magnetic field produced by the field poles remains stationary.

The North pole of the field pole attracts the South pole of the armature, which turns in response to this magnetic attraction. But in order to keep the armature turning, you must break the current and change the polarity of the armature magnet. Otherwise the armature would remain permanently fixed in one position for as long as electric current was flowing and nothing would move.

Breaking the electric current through the armature and reversing its direction is done by a switch consisting of brushes and commutators. The commutators attach directly to the motor due to their location on the shaft and are connected to the armature by the wires threaded through them. The brushes rest lightly against the wires connecting the commutators to the armature. The brushes complete the electric circuit and enable the electric current to flow into the armature wires.

If the electricity always flowed in the same direction, the field magnet would pull the armature in the same position. It would freeze in this position and there would be no motion. However, just at the height of the attraction of field magnet for armature magnet, when the armature magnet has turned halfway around, the brush strikes the armature wires on the motor shaft to reverse the current's direction. Instead of flowing from the left wing of the armature through to the right, it now flows in the other direction, reversing North and South poles.

The arrangement of wires from armature through commutators is what causes this reversal. Due to this orientation, the armature magnet reverses itself as the armature turns halfway, and the armature completes its revolution as what is now a North pole is repelled by the North pole of the field magnet. The South pole of the armature will be continually turning in a series of half turns to seek the stationary North field pole.

The armature revolves in a complete circle of 360° rather than flipping back and forth in half circles because the momentum of the motor will carry the attraction of North and South a little past the point of peak attraction.

As polarity changes, the armature completes its revolution in an attempt to "catch up" with the change in location of the poles.

Warranty and parts:

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

May we suggest:

615-4685 Toy Motor Kit: This kit contains all you need to build a working DC motor and learn its parts from the inside out! Wind your own armature and field coil; build the commutator with two snap-together pieces. It's a device that's been used for over 40 years to teach crucial concepts. Includes: 2 copper wire coils; plastic base; field poles; armature core; brushes; fasteners. Ages 10 up. Also, in bulk with enough parts for an entire class, 2 students per one set of instructions.

615-4705 Motor Generator: Experiment with AC and DC operation. Build a magneto; universal motor; series and shunt generator. Dissectible device shows crucial similarities. Good for basic training in electricity. Includes: 2-pole armature; field coil pair; permanent magnet pair; 4 brushes; commutator and slip rings; instructions. Field coil and permanent magnets are on interchangeable brackets. You need a 6 V DC power source.

P/N 24-0130

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