

GMK40  
The Magnetic Circuit of the Permanent Magnet Rotor  
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There are a lot of ways to make a Permanent Magnet (PM) rotor, but we are going to take a very simple straightforward approach that is common in the industry. We will use what are known as PM arcs which are just segments of a cylinder. These arc segments will be magnetized radially (in the direction of the radius of the cylinder) which means that on one segment the North pole will be on the outside face of the cylinder and the South pole will be on the inside face. The next segment will be magnetized in the opposite direction. The finished rotor must have the same number of North poles facing out as there South poles facing out and they must be arranged in an alternating fashion. In our rotor we will use 45° arc segments. This gives us 4 North poles facing out and 4 South poles facing out. Arranged like this, we have what is known as a 4 pole rotor. Now we glue these magnet arcs on a steel doughnut. The steel doughnut with magnets attached are pressed on a standard hub-shaft assembly and we have a PM rotor.

Remember from last month that magnetic flux always flows from a North pole to a South pole and will follow the path of least resistance. The steel doughnut provides an easy path for the flux on the North inside pole of one magnet to flow to the South inside poles of the magnets next to it. Now lets drop the rotor into a PSC motor stator so that the 8 magnet faces line up with the stator pole faces, and see what happens to the magnet flux from one of the magnets. The flux leaves the North pole of the magnet, jumps the small air gap to the stator, easily flows through the stator pole, the outside ring of the stator (known as the stator yoke), flows through another stator pole, jumps the air gap again and flows back into the South pole of adjacent magnet. The flux then flows through the magnet, into the steel doughnut and back into the South pole of the magnet it originally left. Just as we said last month, the magnetic flux has flowed in a complete loop - the flux that left the North pole has flowed through several parts of the motor and eventually returned to the South pole. This path is known as the magnetic circuit. Although it is much more complicated, this magnetic circuit can be analyzed much like an electrical circuit.

Now that we have the rotor's magnetic flux established in the motor, we need to see what we have to do in the stator too produce motor action. It's going to be a little more difficult than simply plugging it in to the AC power line, but that's next month's subject.