

WIRELESS MOTORS

Compact, high-power, lightweight, low-cost and highly-efficient linear and rotary motors without wires or backing iron



An electric motor generally consists of two parts – the first of which is designed to produce a magnetic field pattern of strength **B** and the second of which is designed to pass currents of magnitude **I** through wires of effective length **L** that are immersed in the magnetic field pattern. The motor works because the wires in the second part of the motor experience a force whose magnitude **P** is the simple product of the current, the field strength and the length of the wire. That is to say, $P = B \cdot I \cdot L$. There is an equal and opposite reaction in the other part of the motor.

A conventional electric motor (like that shown here) is made from a stack of iron laminations in which there are many deep slots. The slots are insulated and a number of turns of copper wire are packed into them. It is sometimes difficult to tell the difference between the two parts of the motor, which are similar in appearance, but in one part of the machine the electric currents energise iron electromagnets that produce the magnetic flux – whilst in the other part of the motor the iron conducts that magnetic flux to the wires that carry the electric current.

One part of the motor is stationary and is called the stator – the other part moves relative to the stator and is called the armature. Generally the armature moves in bearings that keep it close to but not touching the stator, with a very small gap between them, which the magnetic field has to cross. The air gap of a conventional motor is usually around a millimetre in length and the wires are effectively immersed in a field strength **B** of about 0.6 Tesla.

Electric motors have been made that way for more than a hundred years. Even when powerful permanent magnets became available, motors became more efficient and the magnetic part changed its appearance, the electrical part stayed almost the same and the working flux density **B** remained about 0.6 Tesla.

But there have been three important developments that have completely changed the way that electric motors can be designed: -

1. Very powerful permanent magnets are available at acceptable cost
2. Reliable electronic equipment is capable of controlling high electrical powers rapidly and precisely
3. Simple and reliable bonding techniques have been developed for component assembly.

DURING THE LAST TWELVE MONTHS there has been a series of design breakthroughs, which are protected by a growing number of patent applications – and **which are now offered for licensed manufacture and distribution worldwide.** Wireless motors are more powerful, more compact, lighter in weight, more efficient and lower in cost than motors of comparable performance that have been made by conventional methods.

POTENTIAL LICENSEES should first contact: -

SHEKELL MOORING, Rosebank House, Gravel Path, Berkhamsted, Herts HP4 2PF

For the attention of David G Mooring BSc FIILP

Tel: +44 (0) 1442 864830

email: david.mooring@onetel.net

Some of the advantages of wireless motors

The new machines have no wires like those of conventional machines – the function of the wires is performed instead by sheets of copper or aluminium into which patterns are cut to define the current paths - and the metal sheets are then bonded to a surface within the motor. One conductor sheet can replace hundreds of wire coils, so that eliminating the wires reduces the manufacturing cost and increases the reliability at the same time.

The magnetic field pattern is produced by arrays of magnets and iron pole pieces that are designed to increase the working flux density to the point of iron saturation – typically at around two Tesla. That is three times the working flux density of a conventional motor and as a result, the motor produces three times the force (or torque) for the same drive current – and the heat in the conductors (“copper loss”) is reduced by an order of magnitude.

The magnetic air gap is much larger than that of a conventional machine – typically a centimetre instead of a millimetre. As a result, the laminar conductors can be placed directly into the dense magnetic field instead of being fitted into slots in the iron part of the motor. The wide air gap also allows the stator and the armature to be hermetically sealed in separate “cans”, which is a common requirement for explosive or sterile environments.

The magnetic field components can be arranged in pairs on either side of the laminar conductor arrays - and as a result **there is no need for any iron (“backing iron”) in the electrical part of the motor**. Wireless machines are therefore lighter than conventional motors. It should be noted that the direction of the magnetic flux in backing iron has to keep reversing its direction as the motor moves - and whenever it does so some energy is wasted in the material of the iron. Wireless motors have no iron losses.

The laminar conductors and the magnetic field arrays that form a complete motor unit are light in weight and narrow in form. **Miniature low-cost motors can be developed** for a variety of consumer applications

Many motor units can be stacked together to produce a very powerful machine. A large number of such thin elemental motors can be packed into a small space – and by a patented re-arrangement of their magnetic field arrays, the close-packed units can be made even narrower so that yet more of them can be packed into any chosen volume and linked together mechanically.

For example, many linear motors can be grouped around a central thrust rod or tube to produce a high-thrust linear actuator. Such a compact machine might produce a thrust of a mega Newton (100 tonnes wt). Alternatively, the array of motor elements can be wrapped around a central shaft in a different way to form a high torque (gearless) rotary motor with a torque of (say) 250 kNm.

The new motors are flexible in their topology and can move in three dimensions, so that a single motor can be designed to produce a complex movement. Wireless motors can perform tasks that are beyond the capability of conventional machines.

Throughout the world, for manufacturing industry as well as for defence purposes, there is an urgent need to eliminate the noise, fire-risk, contamination and unreliability of hydraulic equipment and **to replace hydraulic rams with linear electric motors**. Rotary ball and roller screw actuators have been tried, but they have many moving parts that wear quickly and they are relatively slow, noisy and sensitive to mechanical shock.

WIRELESS MOTORS represent the only technology by which one or more hydraulic actuators in a dynamic application can be replaced by a robust electrical machine with only one moving part.