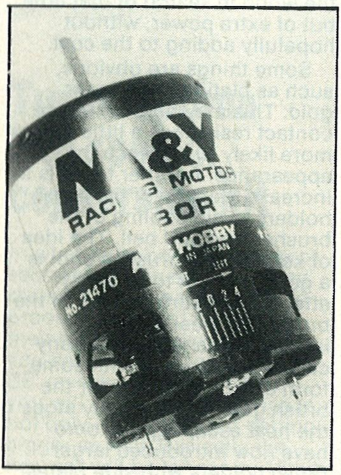
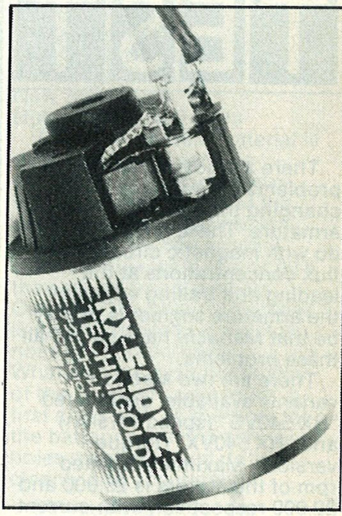
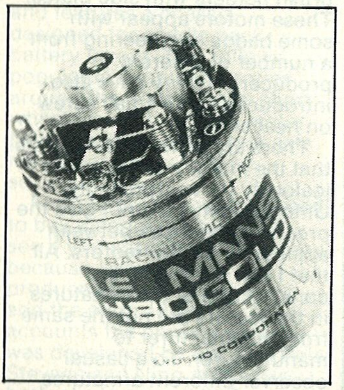
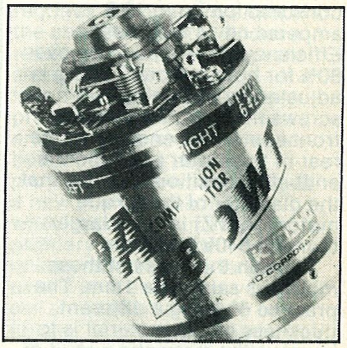
Motors... the latest



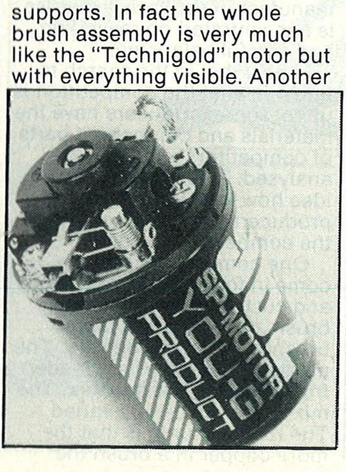


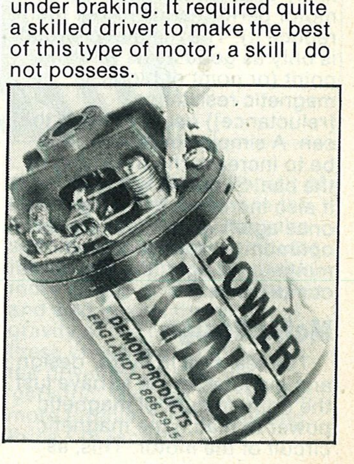




From time to time I have written articles on some of the technicalities and changes that have taken place with 1/10th motors. It seems an appropriate moment to have another look at motors especially as *Mabuchi* are launching a new motor.

This new *Mabuchi* motor will also appear with a *Tamiya* label (known as "Dynatech 01R"). The new motor is a significant departure from other *Mabuchi* motor designs. The most noticeable feature is the external brush gear. This is the first time that *Mabuchi* have gone for totally exposed brush gear in this size of motor. Points of interest include separate single leaf springs for brush tension and replaceable brushes mounted on metal supports. In fact the whole brush assembly is very much like the "Technigold" motor but with everything visible. Another change is the introduction of what *Mabuchi* are calling a "Cut Core Rotor". This style of armature is flat topped. Instead of the armature laminations following a circle they are levelled off. this saves weight but provides little or no material to drill out for balancing. The balancing problem is overcome by attaching weights to the motor windings. Before everyone cries foul, this practice has been used in the past by *Yokomo* (and probably others). Some time ago I experimented with different shapes of armature with little success. The problem I found was that in reducing the mass of the armature and allowing more rapid acceleration, the flywheel effect is lost and hence the car stopped a little too quickly under braking. It required quite a skilled driver to make the best of this type of motor, a skill I do not possess.





On TEST

There are some technical problems introduced by changing the shape of the armature. These are mainly to do with magnetic circuitry and flux concentrations at the leading and trailing edges of the armature segments. It may be that *Mabuchi* have solved all these problems.

There are two *Mabuchi* variants available, designated "RX 540VS" (speed version) and "RX 540VX" (torque version). Maximum claimed rpm of the motors is 25,000 and 22,000 respectively with current consumption up to 12.5 amperes nd 14 amperes. Efficiency is claimed to be over 80% for both motors. Timing is adjusted by loosening two screws that pass through the front aluminium end cap to the rear of the motor and hold the endbell in position. I notice that the diameter of the torque motor (540VZ) is 1mm larger than the 540VS version.

The can thickness of these motors is said to be 1mm. The practice of using a different thickness of can material is to improve the magnetic circuit of the motor. This principle has been employed by various motor producers for some time. One of the first companies to do this was *Demon Products* when they moved from 0.8mm to a 1mm-thick can. Most manufacturers have now followed this lead. there is available an even thicker can, namely 1.2mm. The advantage of increasing can thickness is a lower reluctance of the magnetic circuit of the motor. This allows more efficient use of the available magnetic power or in some cases a more powerful magnet can be used.

It is a common misconception that simply increasing the strength of the magnets will increase the power of the motor. This is simply not true. In fact it is likely to do nothing at all for motor performance (other than reduce it). The magnetic circuit is only as good as its weakest point (or point of highest magnetic resistance [reluctance]) usually that is the can. A simple solution would be to increase the thickness of the can. Sure this will help but it also increases the weight. So once again we are looking for optimum performance and minimum weight, the inevitable compromise.

Motor design

The real skill in motor design and manufacture is to have just the right amount of magnetic power to match the magnetic circuit of the motor. This, as you guess is one of the trade's closely-guarded secrets.

There are a few other developments going on around the world in search of that little but of extra power, without hopefully adding to the cost.

Some things are obvious, such as plating brush gear gold. This may help to reduce contact resistance a little but is more likely to enhance the appearance. Another trend is to increase the area of the brush holders to aid cooling of the brushes and end bell. The idea of keeping the brushes cool is a good one but to be really effective the surface area of the brush gear needs to be increased many times. In any case most cars run with some form of motor cover over the brush gear which simply stops the heat escaping. *Yokomo* have now introduced larger brush holders with side plates. These motors appear with some badge engineering from a number of different producers. *Trinity* have also introduced some small screw on heat sinks.

There are some other secrets that the motor makers guard jealously (not surprisingly). Unfortunately I cannot give the precise differences between apparently similar motors. All that I can say is that the construction of the armatures in the motors are not the same from manufacturer to manufacturer. To a casual observer different armatures may look identical. There are some differences, but to spot the differences you will have to look pretty carefully.

Another variation between motors which you simply cannot see is the materials that the motors are made from. It is easy to appreciate that some steels and irons have better magnetic properties than others. The motor can will need a material that retains its magnetism whereas an armature should be made from a material that can easily lose its magnetism.

Most of the companies who produce their own motors know what makes a good motor and what does not. The rewinders of motors even if they know what makes a good motor good, must still make do with the products of the motor manufacturers. Their expertise is concentrated on rewinding and careful balancing.

I know that in the search to find out what the competition is up to, some producers have the materials and component parts of competitors' motors analysed. This gives you some idea how keen motor producers are to find out what the competition is up to.

One component that has come in for a lot of adaptation and customising is the motor brush, or to be exact motor brushes. Materials do vary. The majority of brushes are made from a copper carbon mix. The mix of course can be varied. The rule of thumb is that the more copper in a brush the softer it is, the better it conducts, the quicker it wears. Silver compounds have also been tried, with some useful results, although to be fair they were not outstandingly different from copper-based compounds. I suppose that gold would make a pretty good brush material, it is certainly used in other types of motor, usually where cost is not a factor. Finally we have the reprofiled brush. This allows a greater amount of pressure to be exerted on a small area of the commutator. The higher the pressure, the better the contact, but remember, the higher the pressure, the higher the wear, and the higher the friction. Sometimes it works, sometimes not.

Some manufacturers such as *Intronics* have gone for producing some new brush gear fitted to conventional motor endbells. This design uses particularly small brushes, similar to the type used in some electric slot cars.

No arm in trying

perhaps one of the most important areas of motor manufacturing is armature balancing. In the case of modified motors i.e. the ones with variable timing; the armature can always be removed and balanced by one of a number of specialist companies. The very best form of balancing is the end to end type. This means that both ends of the armature is balanced independent of the other. Strange as it may seem, the armature can be made out of balance by differing amounts at either end. this is usually indicated by balancing holes having been drilled at either end of the armature.

Standard motors can only be balanced during initial manufacture, as the cans are then tabbed it is impossible to remove the armature without lifting the tabs. This renders the motor "illegal" as far as the BRCA rules are concerned.

Bearings on standard motors have gone through numerous phases. initially phosphor bronze was the favoured material, but as motor performance increased this bearing material tended to wear rapidly. The sintered iron bearing has proved to be a much better bearing as far as wear is concerned. Now many of the "standard" types of motor use this beating material. A little while ago *Demon* introduced a ball-raced standard motor. I thought at the time that this was an excellent move. It improved motor performance and dramatically reduced motor failures due to premature bearing failure, and it fell inside the fixed price limit. Sadly as soon as this motor was finding favour and winning races, in lumber the BRCA and for some reason not entirely clear to me pronounce it illegal.

Another new variation in motor design is from *Trinity*. They have introduced an all-metal end bell for their latest moors. This, as mentioned earlier will help in the dissipation of heat from brushes and end bell bearing. This practice has been used by *Kyosho* on some of their more expensive motors such as the "Gold" for some time. One other feature that *Kyosho* have favoured on some of their motors is to stagger the laminations of the armature. This practice is claimed to give a smother power take up. It is the sort of facility appreciated by model railway buffs more than 1/10th racers, which may explain why virtually no other manufacturer has done for the idea.

Magnets have had their fair amount of development over the years and is an area where we can expect to see some of the most exciting developments in the years to come. Since the introduction of wet-type magnets, first used by *Kyosho* and later offered by just about everyone, not much has apparently happened in the car world. This does not mean that things are standing still. Investigations and developments still continue into the use of alternative magnetic materials, including the rare earth types. Once again the BRCA have stepped in to introduce rules preventing its use. Fortunately other ideas of the modelling world are not so Luddite in their ideas and have encouraged the use of rare earth magnets especially in electric flight.

I have used rare earth magnets in cars and although the performance is not staggeringly different to either wet or normal magnets, the magnetic performance does not appear to go off so readily as the motor ages. If you are in a club that allows any type of motor or an individual who just drives an RC car for fun (not competition) it may be that Cobalt types are for you. As far as cost is concerned I know that rare earth magnet motors could come within the BRCA maximum price for modified motors.

A line-up of some of the post popular manufacturers and modifiers from around the world. Some of these types are not commonly available in the UK. This is not a definitive list.

Mabuchi
Igarashi
Johnson
Yokomo
Demon
ABC Hobby (M & Y)
HPI
You-G Oct
Revolution
Trinity
Parma
Checkpoint
Bolink (Igarashi)
Schumacher (Yokomo)
Reedy (Yokomo)
Twister
MG
Tamiya (Mabuchi)
AYK
Air Supply