All You Need To KNOW

Electric Motors

David Gale

In RC electric car racing, there is one item which is undeniably the most critical component in terms of performance and speed, namely the electric motor. Misunderstood and maligned, the electric motor has slowly undergone transformation from a mild and peaceful stock motor, to full blown insanity in the form of todays 'ultra' hot modified's.

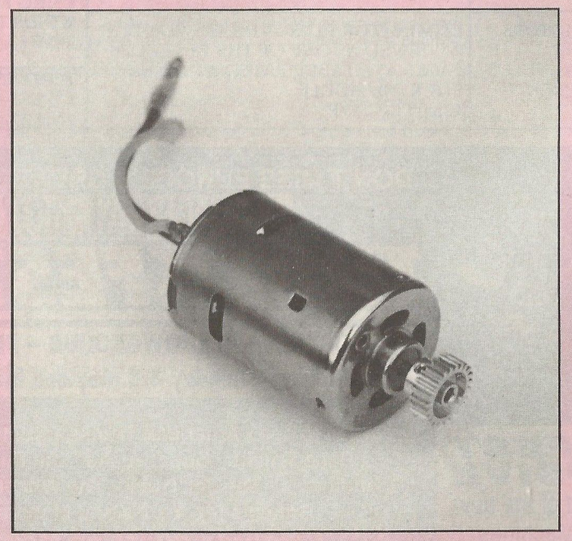
Early motors would have had problems pulling the skin off a custard, and as a result speeds were kept to sensible levels. Sensibility is not something that most RC racers like to be associated with, and as a result motors have been developed that are capable of lapping oval tracks at over 70 mph with acceleration to match. Despite the obvious advancements, the principles have remained the same over the years, with most major improvements coming from better materials and construction methods, rather than anything radical.

A Brief History

When electric RC car racing started back in the 70s, there were only a few choices available:

You could either use an industrial grade motor, or one of the early motors developed for electric flight. Since these flight motors were fairly expensive, it was left to the standard Mabuchi RS540 to become the benchmark, and later when the BRCA was formed to become the foundation for the 'standard' class motor. This set the overall size, and number of turns, which as that time was 35 turns of 23 gauge wire.

As the Mabuchi 540 was only a very crude motor, it was soon modified to give better performance, and this led to the definition of a modified class, which allowed improvements to be carried out, as long as the basic can, endbell, and armature were used. In the late seventies, another make of motor became popular, which was made by another Japanese company, 'Igorashi', called the "O5". Being the same size and electrical specification as the RS540 it was also allowed as a standard motor.



For many years these two motors were treated as equals, but in the early eighties, another manufacturer, Yokomo entered the fray with a new motor design. This was adopted as the standard motor for the first ever 1/12 World Championships, and after winning both standard and modified classes ousted the Mabuchi and Igorashi motors from the top of the class.

What set the Yokomo apart from the other two was that it featured a much better brush arrangement, being accessible from the outside, and it allowed a better contact between the brush and commutator. This allowed the brushes to be replaced very easily, and hence softer brushes could be fitted, to give better performance at the expense of wear. It is this style of motor which has become universal from all the current manufacturers of performance motors, although there are perhaps something like 10-15 different makes. Interestingly most of these will actually be made by yet another Japanese manufacturer, Sagami, who probably make 75% of all the motors we use.

With off road racing taking over in terms of popularity from 1/12 scale, a change to the specification of standard class motors was introduced to make them more suitable. This was to reduce the number of turns from 35 to 27, to give them the extra power needed to cope with another couple of pounds weight.

Given that the style of motor has not changed for nearly ten years, the next major advancement came with improved magnets, namely with the introduction of 'wet' magnets. These gave a much stronger 'field' for the same size, and probably more importantly as far as we are concerned, tend to be less affected by heat than the original ceramic magnets (Incidentally'wet' is the term used to describe the process by which they are manufactured, and doesn't mean that the magnets are liquid). Another improvement came several years ago with the introduction of the new style Yokomo can, as used in the Reedy MR series motors. Again the major improvement was in the magnets, and these are now very popular in many different motors.

When we talk about a motor, the one thing that is normally quoted is the number of turns on the armature, which can range from 19-35 turns. Generally speaking a motor with less turns runs faster, and is more powerful. Unfortunately for us, the current consumption also increases, and as a result the gear ratio needs to be reduced to compensate. For many years this meant that motors were relatively soft, but with the advent of 1700mAh SCE batteries, the number of turns has dropped to allow us to use the extra capacity more efficiently. For each driver there will be a particular motor/gearing combination to suit his/hers driving style on that track, and this is why most top drivers will have large numbers of different motors in their pit boxes.

Standard or Modified Class?

I think at this point it would be a good idea to note the differences between a standard and modified class motor. A standard class motor is one that has been built to size and wind specification, and in which high cost modifications are not allowed. In addition there will normally be a price limit to keep things to sensible proportions.

The current specification for a standard class motor is that it must have a minimum of 27 turns, and meet the general size requirements.

In theory a standard class motor should come directly from the factory in Japan, but in practice they are shipped partly assembled from Japan to the manufacturer who will put his label on it. This manufacturer will then undertake a number of improvements allowed in the rules, to try and ensure better performance.

The only modifications allowed are:

1) Commutator truing.
2) Armature balancing.
3) Wires bonded using epoxy, to prevent movement during use.
4) Brushes and springs replaced.
5) Magnets "zapped" to increase strength.

In addition, when the motor is assembled, the relative position of the brushes with respect to the magnets may be altered to give more advance, which should increase performance.

Note that these modifications are only allowed to be carried out by the manufacturer, who will seal the can after doing so to prevent further tampering. Any motor which shows signs of being opened will be deemed to be illegal, and should not be allowed to be used for racing.

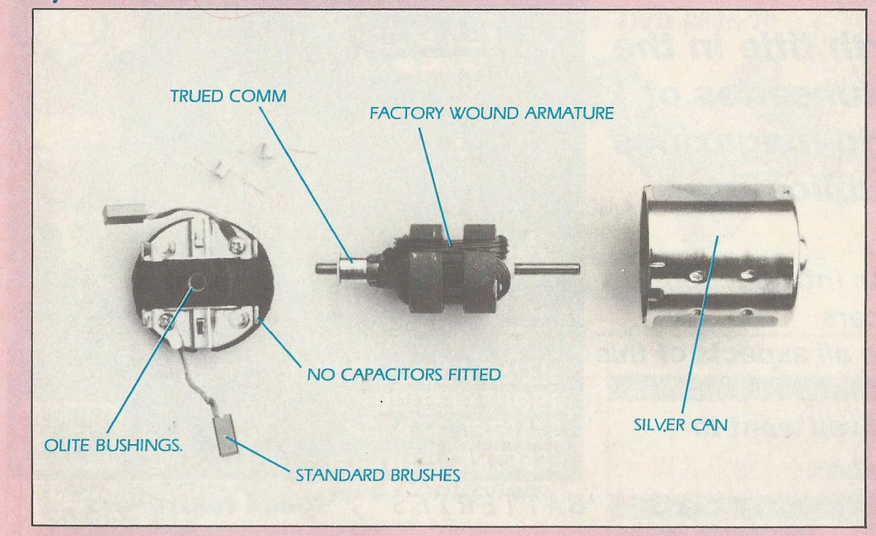
For a modified motor there is a lot more scope available for the manufacturer to improve matters. The only items in common with a standard class motor will be the can, armature stack and endbell. Most of the effort involved will go into putting the wires onto the armature, which will probably come in a large and confusing variety of wind specifications depending on the number of turns, and method of winding.

Whatever the specification, the manufacturer will normally produce a very high quality, and neatly wound armature with soldered connections rather than the mechanical connections used on a standard. With more money involved in modified class motors, the magnets will normally be a higher specification to those used in a standard motor. Instead of plain bushings, a modified motor will normally be fitted with ballraces to minimise friction and reduce play.

Next month we will start to look at the theory governing the way in which a motor works, and how this affects performance on the race track.

The points worth pointing out are

A) FOR A STANDARD CLASS MOTOR



B) FOR A MODIFIED CLASS MOTOR