Nick Adams

COMPETITION ELECTRICS

Modified Class Motors

MODIFIED CLASS RACING for 1/12th cars in this country differs only from the standard class in that the drive motors may be modified. There are two standard motors allowed: the IGARASHI 05 and the MABUCHI RS 540, both with specific requirements for the armature windings etc. These, then, may be used as the basics for modifying within limits as stated in the rules ("motors allowed are any legal standard motors with these modifications allows: rewind, epoxy, balance, trued commutator, motor brushes, cooling holes and ball bearings. The standard cam, magnets, armature and end bell must be used"). There is also one other motor allowed in this country, for modified class racing only, the SAGAMI/CAM/AYK GZ1200 motor.

Price Limits

It is of interest to note that a price list of $50 is imposed in the USA, although no such limit exists here or, as far as I am aware, in any European country.

A price limit of around £30 would favour tuners in this country, although it may also inhibit the import of some of the many models from the USA where sophisticated modifying of the IGARASHI motor is very advanced. However, limited modifications to the MABUCHI only occur at the Japanese source and, as a result, remain quite cheap.

One may wonder why modified motors are expensive and why they are so advanced from the standard motors. The answer is purely the amount of human time required to carry out certain operations such as balancing, which cannot be done completely automatically. Also, you may not have realised that the motors are not solely used in model cars, and many thousands are used in industrial applications where the cost is very critical and the efficiency is not such an important criteria. Therefore, the standard motor remains as a compromise between cost and effectiveness to do its job to a certain degree of acceptance.

Application in Cars

Turning now to the application in cars, there are many ways of increasing the performance of a motor. However, since the cars carry a limited battery supply and the races are of a set length of eight minutes, it is essential that the efficiency is not reduced. Of course, the latter point concerning eight-minute races refers to the National Competitions.

It is recognised that many clubs run shorter races and therefore some motors are tuned to give more power, albeit at the expense of running time. These type of motors are often referred to as "six-minute-winds", (or whatever), by the manufacturers, meaning that, all things being equal, they will not perform satisfactorily in races of longer duration.

A third variation is available with motors made for four-cell cars (instead of the normal six-cell type used in this country). If you try running these motors on six cells, you again get excellent performance, but for a shorter running time. Moreover, the possibility of overheating the motor must decrease its useful life.

Specifics of Tuning

In looking at specific details of tuning I will refer mainly to the popular IGARASHI motor, although most comments apply equally to all motors. The first step in basic tuning is to bre a blue-printed motor.

The blue-printed motor

The blue-printed motor is no more than a standard motor which has been carefully assembled and checked to within the design requirements. This requires neat winding of the armature (rather than throwing on the wire), and thus ensuring not only an equal magnetic performance from each pole, but also ensuring an armature which starts off with an excellent balance therefore requiring very little in the way of balance drillings which in turn decrease performance.

It is not unusual to find one-turn discrepances on standard motors coupled with drillings on the heavy poles to offset the extra weight of wire. The blue-printed armature may still require fine-balancing which can be checked statistically and dynamically and drillings carried out to ensure not only centrifugal balance, but also torsional balance which prevents the armature trying to skew in its bearings.

Before balancing, the windings are coated in either special high-temperature varnish or epoxy-coated during winding. This not only ensures that the windings cannot move and go out of balance, but also stops the rubbing of loose windings which eventually result in a short circuit.

To keep the cost down, the only other modification carried out is to true the commutator, thus ensuring that the brushes stay in contact and minimise sparking and power loss. This sparking is often taken as an out-of-balance armature on a basic motor, but careful running in will minimise it as long as a low voltage of about two volts is used to prevent burning the armature.

The blue-printed motor so far described is available from several manufacturers and will ensure the motor runs as well as one of the best selected standard motors.

End bell modification

Turning now to a situation unlimited by time, effort and cost of tuning, let us look at the end bell which carries the brushes. The simplest modification is to check and set the spring tension and squareness of the brushes so that each runs true and with the minimum friction, at the same time ensuring adequate low resistance contact.

Three legal modified motors: The Mabuchi RS 540 SD; The Igarashi MRP553; The Sagami GZ 1200

In itself, this is a very difficult operation which can be made easier by fitting a specialised assembly such as that used on the SAGAMI motor, where the brushes are pushed down onto the armature by coil springs. This assembly is available for the IGARASHI motor but is hard to obtain in this country.

The brush springs also carry the motor current and offer a small resistance to the current which can become significant under stall conditions, even resulting in overheating and distortion of the brush spring. Flexible copper braid can be soldered from the connector to the brush itself thus decreasing the resistance to the spring assembly. The same barid is used down the centre of coil-spring type brush assemblies.

The brushes themselves are a mix of mainly copper and carbon, but different brushes can be obtained to give lower resistance to both current and friction. Sliding brushes, as on the SAGAMI are readily replaced when worn whereas the IGARASHI cannot have new brushes fitted.

The lead-out wires from the ends of the brush springs should be low resistance and many favour the multistrand flexible silicon-coated wire, not only because of its current rating, but also because it is less easily twisted where such twisting could break off the tag, especially on the IGARASHI motor.

The end bell holds not only the brush assembly, but also the bearing for the end of the armature. This bearing is not so important as the loaded bearing in the metal can and therefore can remain a plain oilite type, as on the MABUCHI RS 540 SD BLACK MOTOR, commonly known as the RED END BELL for obvious reasons. Nevertheless, it is essential that this bearing is fitted exactly in the centre and that it is allowed to seat squarely to the shaft. Most tuners replace this bearing with a ball race at the same time as replacing the main bearing in the can.

Ball races offer a gain in performance only as long as they are kept clean and some tuners deliberately remove the shields so that they can easily be flushed out. The Oilite bearings are made for long life and so reducing their length can also reduce the friction at the cost of a shorter bearing life. These bearings can be oiled with a light oil or universal spray, such as WD40.

The end bell is normally held onto the metal can by strong bent tags, but these will break off quite easily after a few bends. To hold the end bell on, therefore, two small screws are secured into drilled and tapped holes through the can into the plastic end. It is also easier and cheaper to use adhesive tape, but this is messy and can come unstuck when the motor is hot. However, badly fitted end bells can rock against the metal causing side loads on the bearing as well as unseating the brushes, so make sure the end bell is a good, secure fit. The SAGAMI again scores here since it is designed to be screwed into place and cannot rock under any conditions.

Timing

One big advantage of the screwed plastic end bell is that it can be rotated to any position, thus giving infinite timing variations. The MABUCHI and latest SAGAMI motors have special positions already designed in, thus allowing you to assemble in re-timed mode, but they do not offer variable timing.

The RED END BELL MABUCHI comes ready assembled with advanced timing for counter-clockwise running, which is the normal direction used in virtually every model car. If you inspect the edge of the Mabuchi end bell the timing registrations are easily seen. The centre

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registration gives equal performance in either direction, whilst assembling in one of the other two notches gives the required optimum advance for either direction. The actual advance is only about 5° and represents a useful gain in revs without loss of torque, yet, for maximum efficiency, the nominal setting is the best.

It is worth mentioning here that the performance of a tuned motor in a model car is a compromise between acceleration, torque, high-speed power and efficiency at all speeds with minimum current drain under heavy loads. Performance under breaking and running in reverse is normally a lesser consideration.

The timing can especially affect the above parameters and one must take into account the track conditions and whether acceleration can be traded for top speed. The permutations of armature winds, timing, gear ratios etc., for a given race duration on a certain track size are so great it is possible that the optimum motor adjustments are never found by any racer.

Certainly, as far as timing the motor, most tuners settle for a safe small advance or none at all and rely more on the armature windings.

At meetings, you may hear motors being advanced by twisting the backplate, which results in a dramatic increase in revs, but the racer soon finds out this is accompanied by a complete loss of torque, braking and running time. It is not true, unfortunately, that retarding the timing will result in increased torque, but it will make the motor generally very docile.

In the next article on motors, I will discuss the other aspects of the motors. As a postscript, it is interesting to recall that the first European Championship for modified cars took place in Switzerland in February. You may be interested to note in the adjacent table, what motors the top eight finalists (out of 104 entries) were using.

RACE RESULTS — EUROPEAN CHAMPIONSHIP FOR MODIFIED CARS

Position	Name	Motor	Ratio
1st	Neal Francis	Modified Mabuchi — fully reworked	11:48
2nd	Dave Tonge	Igarashi Parma Vette 5-speed	11:48
3rd	Bill Maisey	Igarashi 33-turn, reworked Astro	12:46
4th	Jorgen Andersson	Igarashi 32-turn, 22 gauge reworked	12:45
5th	Phil Greeno	Igarashi MRP 553, 29-turn, orange dot	11:46
6th	George Lond	Igarashi MRP 553, double-wind, blue/green	11:4
7th	John Chamberlain	Igarashi MRP 553, 29-turn, orange dot	11:48
8th	Grahame Davies	Igarashi MRP 553, double-wind, blue/green	11:4

RACE DURATION: Eight minutes plus last lap.
WEIGHT LIMIT: 1lb 15ozs.
TRACK SURFACE: Clean industrial carpet.