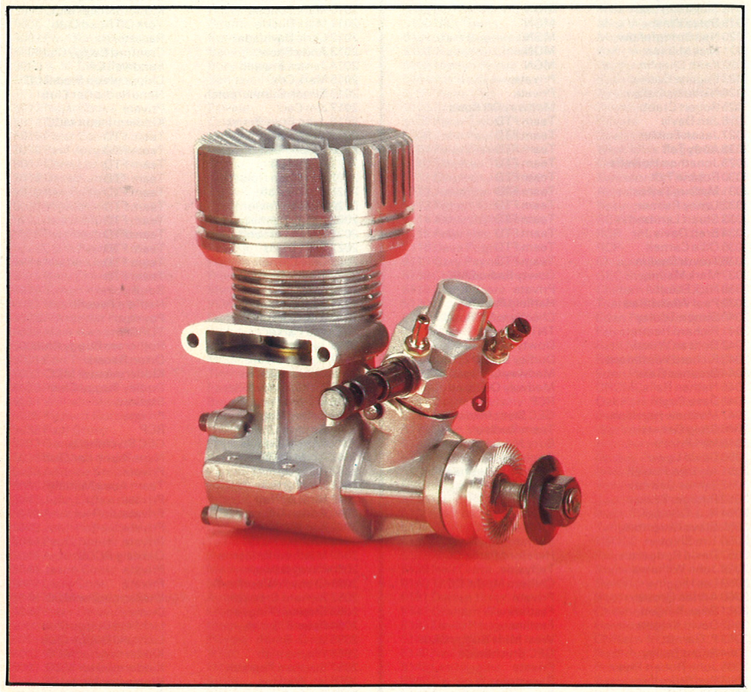
POWER CURVE

by Mike Billinton

MIKE BILLINTON describes the Thunder Tiger .21 and subjects it to some demanding testing.

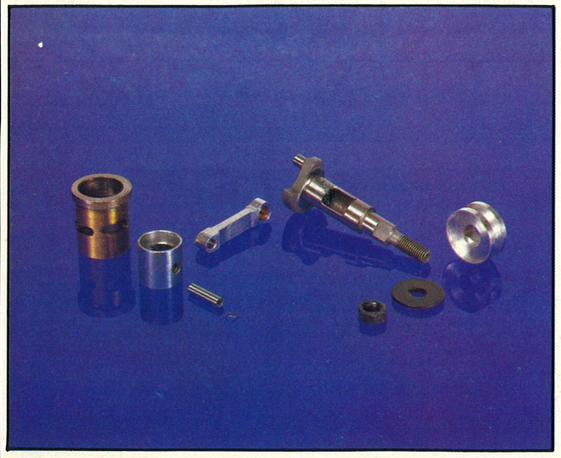


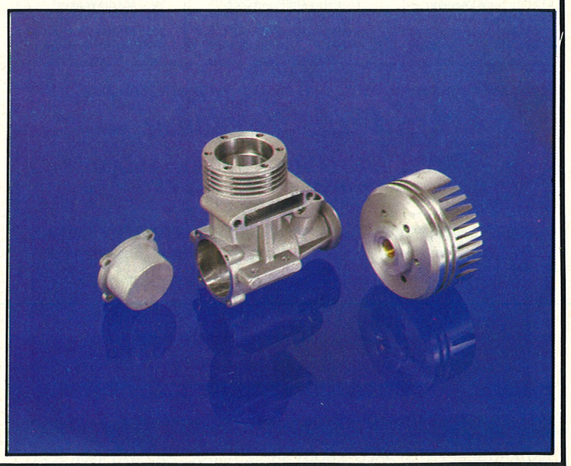
The subject of this engine test provided a first opportunity to assess a technological product from that expanding 'capitalist' enclave off the S.E. coast of China — Taiwan. The Thunder Tiger Model Co. in Taichung, Taiwan currently produces a wide range of modelling products — and engines under the names Royale, Magnum and Thunder Tiger. This .21 car engine is specifically made for the Thunder Tiger Challenger 'runabout' off-road vehicle, and as such is strictly not intended to compete with the very top performers from Italy and Japan which are used to propel Open Class ⅛ racing cars. Its main role is rather to be an inexpensive, reliable, adjunct to that Challenger 'sports' vehicle.

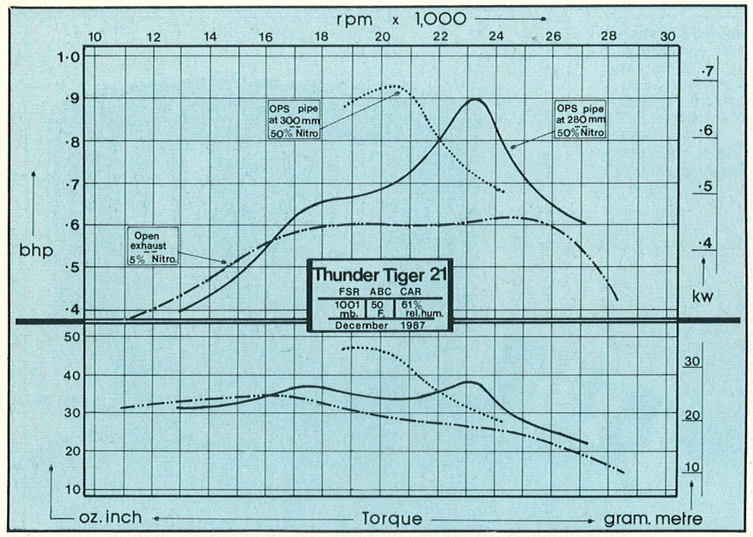
Rather than striking out in a totally new design direction, it is not surprising that the Thunder Tiger .21 has several similarities to certain engines from their highly developed neighbours in Japan.

Judged by the test results achieved here, it can be no surprise that the TT .21 does not yet reach up to the intimidatingly high power levels reached elsewhere, and which have only been attained after many years of hard won contest experience. As an initial entry into this competitive market however, the TT .21 already has much of that important asset — a very reliable and steady performance. Structurally the engine appears able to cope with the likely release of much extra power as experience is gained on the design front, and at 11.8 ozs. overall weight, is in fact amongst the heaviest 3.5cc engines — with the large majority being near or below 10 ozs. Weight alone of course hardly leads to success, though conversely too little material certainly can hinder long-term running reliability. The TT .21's weight is, however, well applied throughout with no hint of potential weakness revealed during the power levels reached during this test.

The Thunder Tigre .21 car engine, sturdily built and ruggedly reliable thanks to its solid engineering.







engine at 3.3 ozs. A brass insert is wisely provided for the plug thread. An angled squish band is used together with a shallow bowler-hat combustion chamber shape. Both squish clearance and compression ratio are set at undemanding figures (.014 in. and 11/1) and suggest more power being available if either or both are 'tightened up'. The carburettor as provided is a standard unit of 7mm bore, using a normal rotating/transversing chromed steel barrel to give control of mid-range and idle fuel mixtures. A main fuel control needle and an adjustable secondary jet are provided. The carb. proved solid, reliable and free from wear during the tests.

Power tests

For an ABC engine, the Thunder Tiger .21 had a quite free piston/liner fit at room temperatures — a point which has gradually become the norm in recent years as a consequence of more precise matching of the alloy metals used in this vital area. It is now recognised that the earlier very tight (even creaking) cold fit is no longer necessary with ABC piston/liner set-ups. The run-

Mechanical detail

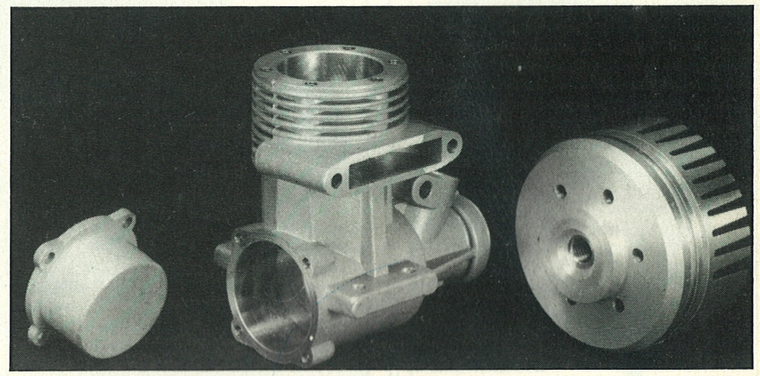
At 3½ ozs. the robust one-piece crankcase is solidly die-cast in aluminium alloy and is well gussetted and braced at all critical points., The usual three Schneurle transfer passages are, contrary to the external appearance, parallel-sided. Utilising the 'ABC' concept, the brass, chromed cylinder liner has a single boost port and two transfer ports with a single exhaust port. Only the boost port is angled in any way relative to cylinder axis — it points up 55°. In keeping with the robust nature of the engine, the upper flange of the liner is a large 3.5mm thick, and though many competitor engines appear not to need this feature (Super Tigre are one exception), it arguably reduces distortion at this thermally heavily loaded point. To reduce proportion times, the liner is additionally recessed far enough down into the crankcase to allow the cylinder head to just sit on top of the liner, rather than plugging into it — as is more normal.

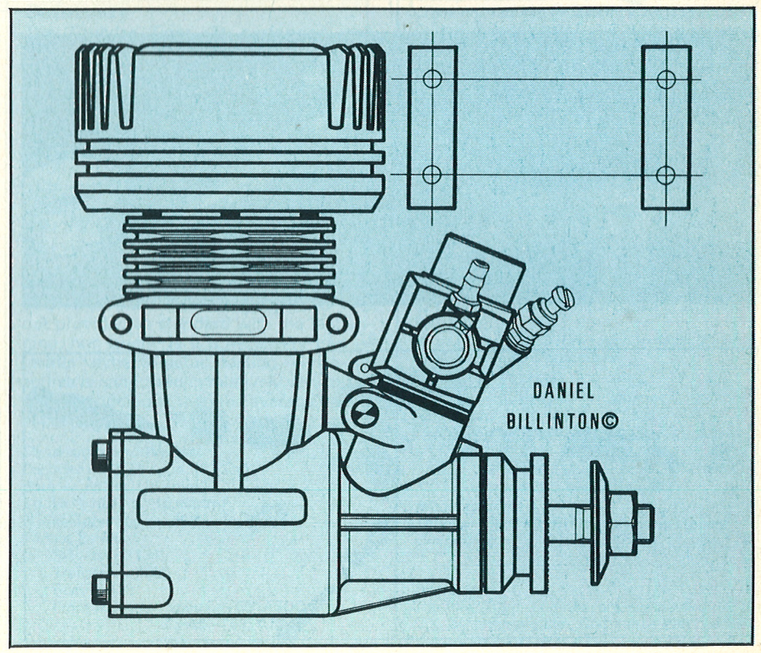
By use of this method, all questions of 'how much plug-in clearance to use' are neatly side-stepped.

The piston is, as usual, cast in high percentage silicon/aluminium alloy — and, judged by the very even wear pattern at the end of test runs, appeared to respond well to the features mentioned above. Equally, the compression seal remained good at termination of test.

Connecting-rod is machined from solid aluminium alloy, and to somewhat larger overall dimensions when compared with many other .21 cu.in. engines. Phosphor-bronze bushing is used at big-end only, and with one lubrication hole only. The hollow gudgeon-pin is finish-ground in hardened steel, and is circlipped into position at each end to prevent intrusion into transfer ports. The liner's relatively short length allows gas flows very good access to bottom of crankcase transfer passages, plus better than average lubrication to bottom half of the exposed piston at BDC. The crankshaft is of hardened steel with integral crankpin, and has a generously large induction throughway of 8.75mm within the 12mm O dia.

The large cylinder-head 'heat-sink' is cast/machined in aluminium alloy, and forms a significant part of the overall weight of the

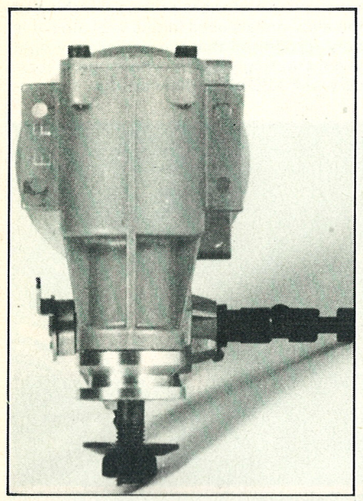


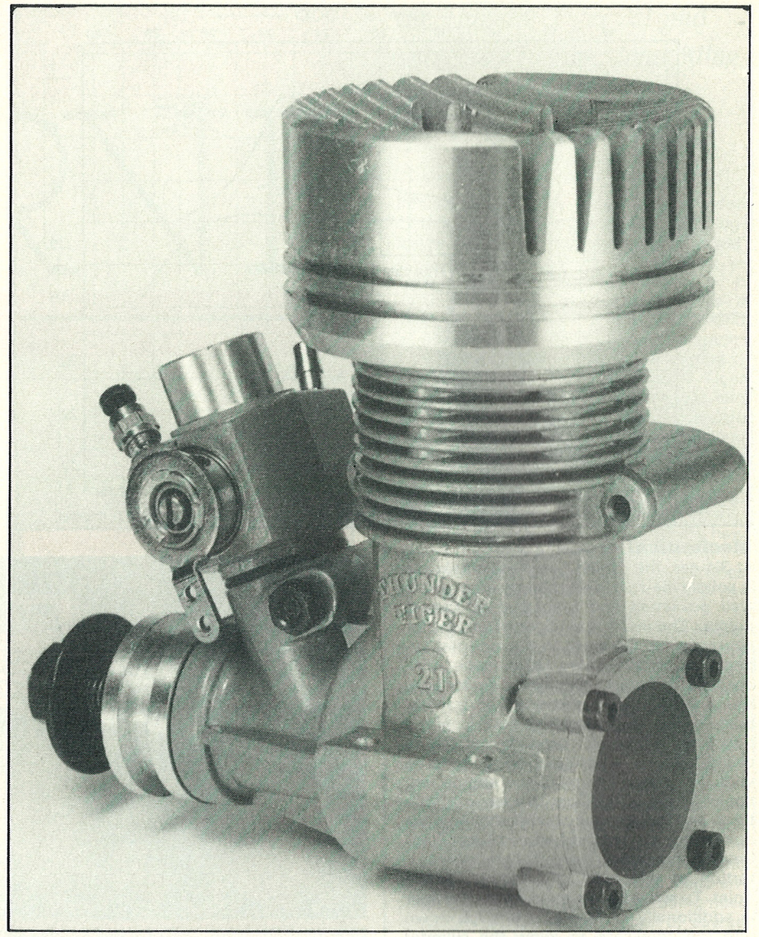


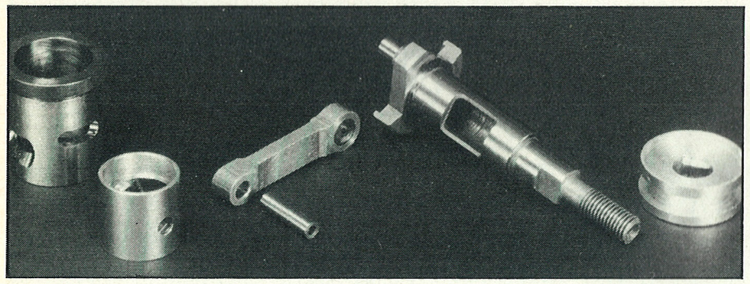
ning-in period for this engine style was as usual quite short-lived, and it was possible to conduct rpm checks on standard propellers after a few minutes slightly rich-running. As expected, rpm's did not reach the highest levels attained by other longer-standing manufacturer's engines but the manner of performance was nevertheless very sound, steady and vibration-free.

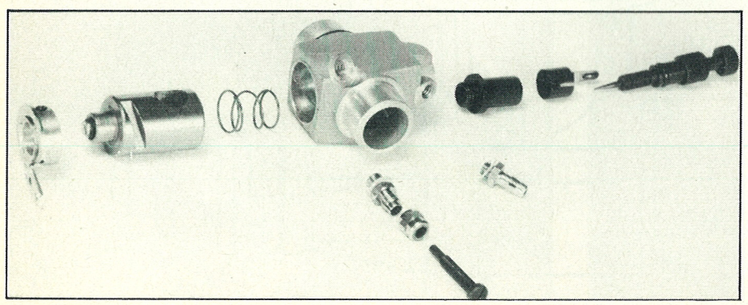
Test 1. Open exhaust/7mm carb/5% nitromethane with 12% Castor oil. OPS 250 glow plug.

Using this standard equipment for comparative purposes confirmed the steady though restrained performance available — the major point of interest being the very wide flat torque band which has obvious importance when allied to the model car's usual single gear. Such a wide torque band has interestingly also been a distinctive feature of previous 'buggy' engines tested. A





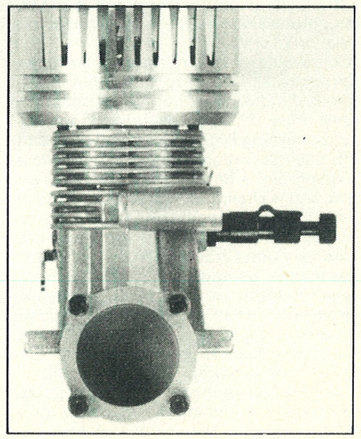


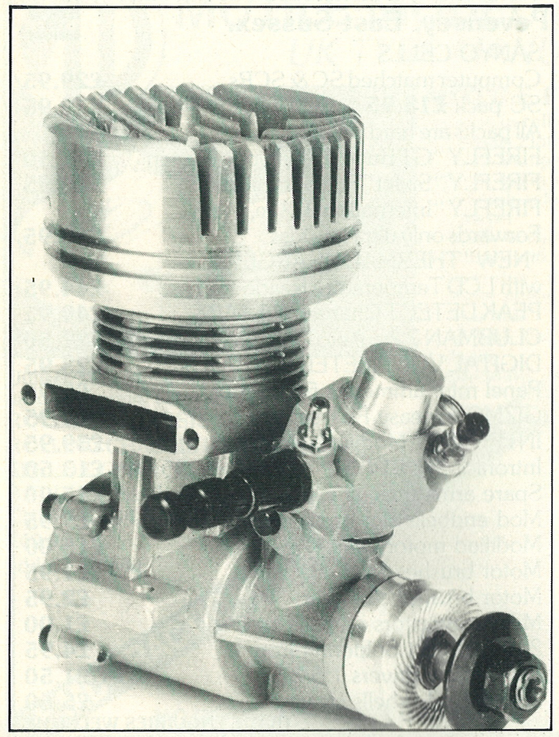


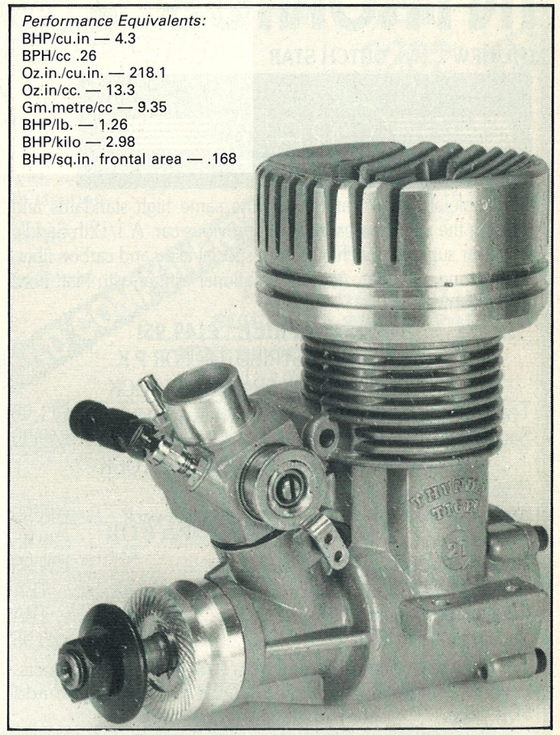
maximum torque of 35 oz.ins. at 16,268 rpm was indicated, and a maximum hp in this open exhaust form of .62 at 24,731 rpm.

Test 2. OPS tuned pipe at 300mm from plug to end of rubber can./50% nitro with 5% Castor and 11% ML70/OS 29 9mm carb/OPS 300 plug.

By use of this trio of 'performance improvers' (pipe/fuel/carb.) it was hoped that







Performance Equivalents:
BHP/cu.in — 4.3
BPH/cc .26
Oz.in./cu.in. — 218.1
Oz.in/cc. — 13.3
Gm.metre/cc — 9.35
BHP/lb. — 1.26
BHP/kilo — 2.98
BHP/sq.in. frontal area — .168

a comparison could be made between the Thunder Tiger .21 and other top performing .21's in the Open Class because, at the time of test, there was some uncertainty as to the engine's real role, whilst also it was not totally clear from the engine's general layout as to its real potential. In hindsight its more appropriate use is clearly in the Buggy or Sports area, and the use of the above 'fearsome threesome' did prove to be largely counterproductive. Pipe length was initially set at the longish 300mm point in order to keep maximum resonance back down to a moderate rpm point. The lack of the usual very large improvement in hp over the open exhaust figures of Test 1, despite the considerable potential effect of the added equipment, was probably due in some measure to the low exhaust timing of 154° which resulted in the small 'blow-down' period of 12° (i.e. the difference between exhaust opening and transfer opening points). Longer periods that this are normally necessary to allow enough time for a meaningful pulse to be generated by the tuned pipe, and which serves to push back into the cylinder that fuel mixture which in open exhaust format usually is lost to atmosphere in moving across from transfer ports to exhaust ports and out — when both are open at the same time.

Test 3. OPS pipe at 280mm rest of equip. as Test 2.

In order to force resonance (such as it was) to occur at higher rpm the pipe was now shortened. The effect of this was to cause resonance now at an rpm of 23,377 and where a torque of 38 ozs.ins. was recorded — with a derived .90 hp.

As can be surmised, the result of these three test curves was to confirm that the Thunder Tiger .21 really does not benefit from excessive amounts of nitromethane, nor really, from a tuned pipe proper. Although no further tests were conducted to prove the point, it is now felt that the more sensible (and economic) equipment to use with the TT .21 is a standard Minipipe silencer and, if necessary, no more than 15% nitromethane.

Summary

The Thunder Tiger .21 performed well throughout and certainly gave the impression of being capable of coping with higher power outputs than it currently delivers. The main points of the engine are the economic ones of: first cost, subsequent running costs, and evident lack of need of a fully tuned pipe or specialist large bore carburettor. With further development this picture is likely to change.

At the end of the test there was virtually no evidence of wear, and so as set-up the TT .21 appears capable of long service.

Assisting in this would be mandatory use of a carburettor air filter, though this was not provided as standard with the test engine, nor strictly is it a necessary part of formal dynamometer testing which of course is conducted in relatively very much cleaner conditions than the average buggy encounters!

Dimensions and Weights:
Capacity — .2155 cu.in. (3.53cc)
Bore — .661 in. (16.8mm)
Stroke — .628 in. (15.96mm)
Stroke/Bore ratio — .95/1
Timing Periods
Exhaust — 154°
Transfer — 130°
Bost — 128°
Front Induction opens — 50° ABDC
closes — 63° ATDC
total period — 193°
Exhaust port height — .193 in. (4.91mm)
Combustion chamber volume — .35cc
Compression ratios — Geometric — 11.08/1
— Effective — 7.99/1
Cylinder head squish — .014 in. (.35mm)
Squish band angle — 4°
Squish band width — .108 in. (2.76mm)
Crankshaft diameter — .472 in. (12mm)
Crank bore — .344 in. (8.75mm)
Crankpin diameter — .197 in. (5mm nominal)
Crank nose thread — .245 in. x 28 TPI (¼ UNF)
Gudgeon pin diameter — .158 in. (4mm nominal)
Connecting rod centres — 31mm
Weight overall — 11.8 ozs. (335 gms.)
Width — 1.81 in. (46mm)
Height — 3.66 in. (93mm)
Length — 2.79 in. (71mm)
Width between bearers — 1.2 in. (30.5mm)
Frontal area — 5.53 sq.ins.
Mounting holes — 38mm x 15.5mm with 3mm holes).

Performance:
Maximum BHP
.93 at 20,509 rpm (OPS pipe at 300mm and 50% nitro)
.62 at 24,731 rpm (open exhaust/5% nitro)
Maximum Torque
47 oz.ins. at 19,000 rpm (OPS pipe at 300mm and 50% nitro)
35 oz.ins. at 16,268 rpm (open exhaust/5% nitro)
RPM on standard propellers:

	Open Exhaust	Pipe 300mm	Pipe 280mm
7 x 6 Taipan	15,468	17,600	—
7 x 4 Taipan	19,612	21,901	22,684

Manufacturer:
Thunder Tiger Model Co., Taichung, Taiwan.
Distributor:

Distributor:
Thunder Tiger Engines are distributed in the U.K. by Amerang Ltd., Commerce Way, Lancing, Sussex.