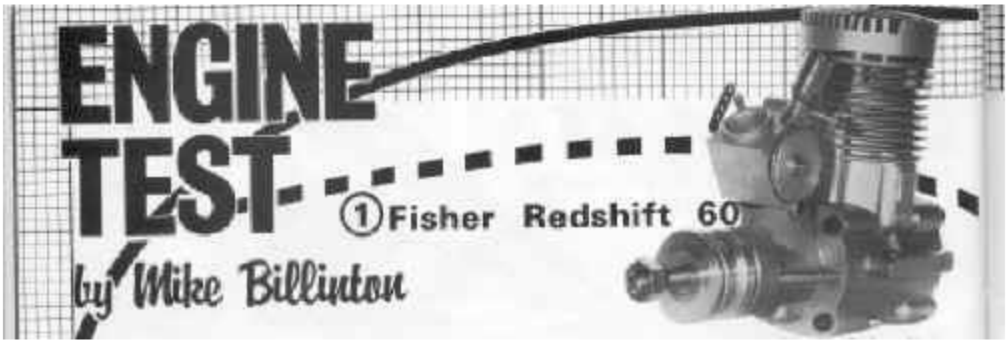
Mike Billinton.

I was lucky enough to be at the Nationals on the occasion Mike Billington was sat at his bench, to the rear of his van, in the sun at Barkston Heath, intently attending to his OS 60 with megaphone pipe. I think that was Saturday, the next day Mike broke the 200 mile an hour barrier with his control line speed model. The dull exhaust note (anything but dull really) of that run is one of those things that will stay with me forever, Thanks Mike, Ashley.



MADE IN SHEFFIELD ... and looks it every inch. Being the creation of designer Richard Fisher, this fine motor is a heartening sign of efforts reaffirming the reputation of this famous steel town.
Assessing this particular test engine's 'fitness for purpose' (and leaving aside British reserve for a moment) it really is an exceptional motor; better in many respects than any so far tested by the writer; the results here support Peter Chinn's earlier test findings, that this product is appreciably above average.
Nothing said here though can have quite the solidity of it's competitive results. This year alone it quietly just happens to have been placed one and two in the SMAE's National Championships R/C Aerobatic class (even to enter which, a series of consistency and reliability proving eliminators has to be hurdled.) Similarly, UK's three-man Aerobatic team for the 1981 World Champs R/C contest in Mexico, happens to contain two "Redshift" users. Again, these were selected after a series of Trials. At the Nationals reportedly, out of the 20 or so qualifiers, seven were users of this engine, a disproportionate number when set against the volume-producers world wide. One knows that fliers as much as motors win contests,

but it's inconceivable that top fliers will seek out the lesser motors the conclusions are there to be drawn.

The Fisher factory team (the team referred to Richard, myself and another acquaintance who had gone along for the ride to record the test results as they happened, Ashley) were present throughout this twoday test programme, this is consistent with the very direct interest they have in each of their products after it leaves their hands. It could be said that the small scale of their operation (tens of engines weekly) means that, being neatly poised between the 'one-off' and the volume producer, they retain some of the considerable advantages of either extreme of production, and moreover direct link with each purchaser remains feasible. Certainly the customer in this particular commercial balance is the outright winner because for little extra cost he's getting the plus features of both commercial approaches. However it is likely that were the motor to be distributed widely through normal retail channels, it's price would be somewhat higher in keeping with higher manufacturing costs. The major reason for conducting this particular test was to assess the sort of performance levels likely with a top Schnuerle 60 R/C front induction tuned pipe unit, and in parallel with this to reconfirm broad conclusions reached in earlier tuned pipe engine tests. In general the findings here were meaningful, whilst the test team of four, including the writer, even managed to learn more than originally aimed for!

Mechanical details

This Tuned pipe Mk. II model is one of six variations on the basic R60 unit the other six being -Standard/Super Scale/Helicopter/Reverse rotation/Marine; anyone of which can be fitted with the factory's exclusive Integral Fuel Metering device (IFM). Each of the variations has a specific feature built-in for that particular use, eg. Super Scale uses a modified crankshaft more suited to high torque at low rpm for those large props. In discussing the various parts it can be taken as read throughout, that all finishes and fits are of the highest standard for this style of construction. Also most of the external surfaces are given a sprayed glass bead finish, resulting in an attractive satin chrome type appearance.

Crankcase - fully heat treated alloy precision investment casting for optimum strength, machinability and stability. Usual three Schnuerle passages but the two transfers are internally fluted to direct gas flow.

Crankshaft - High-tensile alloy case-hardening steel. 17mm OD bored 12mm ID for induction. An exemplary fit in the twin ball races. Prop-driver collet is a sensible 56in. long. Crankcase primary compression is maximised by the unusual total shrouding of the crankweb, which also effectively seals off the extra volume of the rear bearing. The hollow crankpin is plugged for the same reason. Induction port is milled out with a ball-end-mill resulting in greater strength for a given opening width. yet another of the small clever details crowding in as one travels through the engine. Connecting rod - in the Mk. II this is a very solid HE15 affair, again superbly machined, tapered in thickness and in width. little end overall size is larger than is usual with a wider lubrication slot than the big-end slot. Thin wall bronze bushes at each end.

Cylinder Liner - normal machining brass, but in this latest version a change is made from the previous Draloy coating. Information on the new coating is a little guarded at present. It can be said though that it is applied after heat treatment and internal grinding of the liner, and is very thin with none of the electrolytic build-up at ports, common with chrome plating, so there is no final honing process here. The coating is though, finally hardened to around 1100 Vickers. Taper is near to .001 in small at top.

Piston - the matching ring less piston in this set-up, is a nominal 25 per cent silicon alloy investment casting, with substantial gudgeon pin bosses reaching to the crown. A hollow gudgeon pin of through hardening steel is located end wise by normal wire circlips.

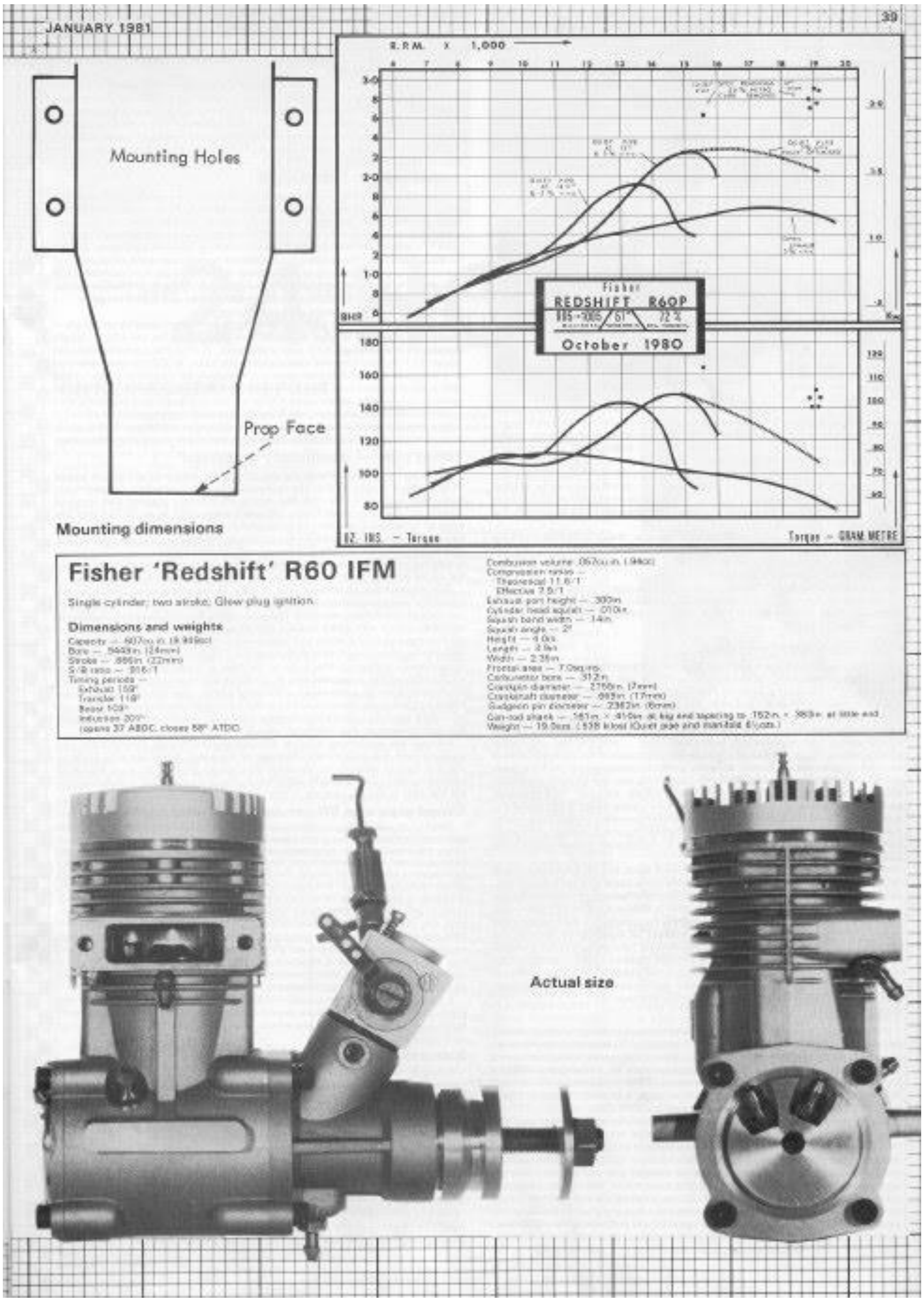
One of the most unusual features of the engine is the narrow brass anti-distortion ring fitted between the HE30 cylinder head and crankcase just outside the periphery of the circle of head bolts. This is claimed to prevent cylinder pinching effects at TDC resultant from the bowing downwards of the usually unsupported cylinder head flange. Seems very logical results indicate its effectiveness with reports of very long cylinder life. The only problem arising is the careful fitting required. Accurate steel shimming has to achieve just the correct amount (and no more) of sealing pressure of cylinder-head against liner flange. This fitment is assisted by the now recommended slow setting Araldite as a 'gasket' material. Amongst many other neat touches (space precludes mention of them all)" the fact that all threaded holes are counter bored about two thread depths both to provide an easy and accurate start to the Allen head bolts and to prevent the unsatisfactory lifting of metal at joint faces where threads are brought right to the surface, is instructive of the thoroughness one finds throughout this motor. This writer for one wouldn't have objected had all his speed C/L motors been of this overall quality.

Tuned pipe points

Formal testing of Tuned pipe motors not being a significantly documented area, some preliminary deliberations seemed in order if the results were to be meaningful. After discussion with interested parties, it seemed clear that the earlier idea of optimising the pipe's many parameters for each rpm point on the hoped for torque curve was not an ideal way of proceeding, and would in any case be a very long-winded affair with the likely misleading result of a very flat curve (of enormous width and power) bearing little relation to our known experience of tuned-pipe behaviour.

During normal testing one does not adjust port timings in this way, nor the other myriad built-in features that can affect power at differing rpm's. Again, to do so would result in a recognisably 'manipulated' Torque curve. It was felt then, that the argument really boiled down to this: How simple and easy to adjust is the particular variable provided by the manufacturer? Traditionally only fuel/air mixture, compression ratios in diesels, and variable ignition timing (where provided), are optimised during power tests. Virtually all other possible variables are taken 'as is' and remain unmoved during the Torque tests over the whole rpm range. The Tuned pipe falls awkwardly between the two stools. We can adjust it but not that conveniently. It seemed to the writer then a difficult (maybe pointless) task to attempt an escape from the inevitable very sharp peaks, even multi peaks, which would probably result from full rpm range testing of a tuned-pipe motor, with a fixed pipe length capacity to justify any course of action soon demonstrated that this fixed length method would at least reveal any advances being made in band width flexibility resulting from new pipe designs! Whilst conversely, continual adjustments to pipe parameters during tests (the earlier idea) would largely obscure this flexibility point, and was therefore a major final justification. Testing procedure was now a matter simply of deciding in advance the general area of operating rpm required, and then adjusting the pipe's length to give the highest rpm gain at that point. The decision as to which area, can be based on a desire to operate at low; quiet RPM; or alternatively at the motor's known (or suspected) max. open exhaust peak BHP point, or even higher rpm points if one wishes. To quite a large extent, the motor will happily follow the dictates of the pipe's length. Long pipe equals low rpm and vice versa. Having thus arrived at a fixed length, full power tests are then conducted as normal over as wide an RPM range as seems sensible; with the results as shown on the graph.

Above: Redshift 60 is a beefy looking engine, note the ED AMC carb, and the exhaust pressure sensing system coupling from the IFM regulator. See text for description.



Having come to this general conclusion however, there remained a lurking suspicion that testing this way was not a total answer, and certainly did not inform one as to the maximum bhp possible when using the most effective combination of pipe length and rpm. So, because of the strong interest shown by Dick Fisher in the difficult alternative method of testing, a further set of figures was obtained by progressively shortening the pipe each time the load was reduced incrementally. Dotted line on graph shows this finding.

Pipe connections and gaps

One area of interest was revealed during the 'continually optimised' test, that the suspected inefficiency of allowing gaps of over 2mm or so between pipe and manifold, or between the sections of temporary tubular spacers in the silicon connector, really is a weakness, and rpm losses can amount to 600 or more if these gaps are too large. During optimising therefore these gaps were always kept to a minimum. Other irregularities, such as curvature mal-alignments in the joining sleeve, also revealed rpm loss on occasions, and this was not always audible. All meaning. that close fit and careful alignment of the separate parts of the pipe system pays dividends. A further point of interest which the Mfrs. have come to realise since the first motors appeared, is that the fixing of manifolds with a jubilee strap around the crankcase is strictly 'no good.' This of course particularly affects the very close fits of ABC type piston/liners. It will cause distortion in the medium term, and may even cut performance immediately due to the constricting effect caused by even mild tightening of such straps, quite apart from the worsening effect as heat rises, due to the differential expansions of the steel strap and the aluminium crankcase. Again, manifolds bolting against the exhaust stack should themselves have flat, unbowed mating faces, to avert possible distortions; and yet another suspected problem area (not yet confirmed) is that use off ferrous manifolds bolted to alloy cases may cause 'thermal bowing' due to different expansion rates with heat. This is tied-in of course with. how tight is the bolting; is a thick gasket used at the joint; how strong are the parts anyway? Of significance then (in the writer's view at least) is that the Rossi rear exhaust 10cc motor has the manifold held gently but inescapably against the exhaust stack by spring connection; an O-ring providing the gas seal. The method disposing of at least three problems at once. The main advice though is to maintain awareness of this general problem area, certainly where close piston to liner fits are involved.

Power tests

This particular motor was quite new, but had already undergone some running and was considered ready for the tests. These were 70 separate runs either on open exhaust or with the HP 'quiet pipe.' Where necessary correction factors have been applied to the bhp figures to compensate for air densities differing from the British Standard of 29.92in. pressure/60°F temperature/75 per cent R, humidity. Only rarely do these factors loom large; in this test they ranged from 1,018 to 1_03. Plug used in all the tests was the OPS300, The HP happens to be the favoured pipe of the Fisher team, and so very few runs were undertaken with any other pipe. those that were proved slightly inferior but inconclusive, as little effort was put in to optimising them. These alternative pipe designs though, reminded the team forcibly, that here was yet another variable which could be fed into the complex mix, and we were only too well aware that varying lengths of the pipe alone left many questions unanswered. It did equate though with the likely tuning the average user would attempt, Not having a Honeywel1 computer in the test shed nor in any case the capacity to feed it meaningful data, we opted for the simple major variable: that of length. Assuredly there's more to come from other combinations of variables,

Open exhaust
This five per cent nitro and castor test showed slightly less power than Peter Chinn's test and the fact of a different motor (with higher exhaust timing) could account for this fairly small difference. Slightly unexpected was the higher peak at 17 ,600 rpm a little unusual for a front induction unit with smallish R/C carb. Highest torque in this open exhaust mode came in at same speed as Peter's 11,000 rpm but was of lower value at 111 oz.ins, again probably due to the higher exhaust timing.

Tuned pipe at fixed length
Now the awkward bit and real time consumer. As readers will note, the helter-skelter curves refer to the situations resulting from using two different fixed lengths (also five per nitro) and then, as normal, reducing load progressively to allow rpm to rise; which it eventually does precipitously, and up goes the torque with it. This effect is well

known to all tuned pipe users, but is a bit disconcerting to those new to it. Unlike the normal open exhaust situation of maximum torque appearing at much lower rpm than does maximum bhp, it is interesting to see resulting from the tuned pipe's very steep-sided torque curves, that the maximum bhp and maximum torque appear at similar rpm dynamic point which is obvious to users anyway. Definition of 'length of pipe' is that which is commonly used by operators 'maximum diameter of pipe to piston face. The curve for the 14 1/2in. length represents the average R/C user's situation, in that the normally favoured Zinger 11 x 7 1/2 will keep the motor back in the 12 to 14,000 rpm area, and thus this length of pipe is of correct resonant frequency for maximum power in this rpm area. The next curve shows the effect of shortening the pipe to 13in. in an attempt to push the whole curve higher on the rpm scale (and hopefully thus raise bhp value at the same time). This effect is clear on the graph and serves to indicate the comparative strangle hold the pipe has on the motor. At this higher bhp point though, it was now not possible to use the previous Zinger propeller.

Tuned pipe -continually optimised

The process of again shortening the pipe to yet another fixed length looked likely to result in even further bhp gains at higher rpm; however it was decided to cover that point with this next test where an arbitrary starting pipe length of 13 1/2in. at 14,670 rpm was finally optimised down to 9 3/4in. at 19, 150 rpm. We were all expecting a very flat bhp curve, and so it turned out. Additionally, we had been anticipating bhp maximum would now be reached at a considerably higher rpm point (possibly 19,000) in keeping with a tuned pipe's capacity to improve breathing (and thus torque) at a higher than normal rpm. Revealed instead was a flat curve actually peaking at a lower point than the motor's open exhaust! This confounded all present, and in view of the unexpected nature of this result it is being treated by the 'test team' as a slightly provisional finding, which it is hoped to verify later on similar styles of engine. Nevertheless it did happen as indicated (albeit with some scatter) and all agreed that the curve (dashed line) broadly represents the event as it happened, there being no questions of the motor giving more power as rpm rose past the 17K point whilst the pipe was being progressively shortened The score so far then, is Tuned pipe one test team nil. Dick Fisher has suggested that as the pipe has a normal back-pressure effect (quite apart from its advantageous features) so then, just like the usual silencer effect on bhp curves, there could be just such a restrictive effect on the maximum rpm point, even though the bhp remains quite high. Clearly more tests will point the way forward on this particular aspect. Anyway the optimising method did give slightly higher bhp of 2.28, and together with the considerable flatness of the curve, leads one to suggest there a market waiting for someone who could arrange for such continual optimising variations of length whilst the motor is 'on the move'! Rumours that the Far East is already looking in that direction are probably true.

Tuned pipe and 50 percent nitro and higher (With carburettor removed and thus mainly of academic interest). These few spot checks shown on the graph were not expanded further into a full test curve partly because of time considerations and also because most users would operate on the much milder fuels. Part or all of the oil here was ML70. Not surprisingly for this style of motor, the Redshift had the normal quite high uplift when using Hi-Nitro fuel; but when attempts were made to build even further on that with a nasty 72 per cent nitro with ten per cent propylene oxide (and thus hope to get over three bhp), there proved to be no increase at all over the 50 per cent mix. This was almost certainly because of much greater heat release and thus the pipe would need yet more optimising (speed of sound changes with temperature). Well, the team was by this time almost fully de-optimised and had run out of steam, plus a deadline was looming. Therefore the tests were terminated at this point, having reached 2.9 bhp in less than optimum conditions as to pipe length and possibly volume.

A final general point, the question of scatter and anomalies in tuned pipe test readings is likely to remain more severe than is ever the case with open exhaust motors, which by comparison seem to act more like a rack and pinion mechanism so predictable are they.

Integral fuel metering device

Although the manufacturer had failed to break their motor (a quite welcome finding of course), unforeseen, the neat propylene oxide itself had attacked a vital small '0'ring in the fuel valve, consequently no further tests were possible with this IFM system and this included the normally useful 'idling response' test. Unfortunately this part of the test had to be abandoned. The ED AMC multi-carb (standard supply with the 'Redshift' is well known in any event. This is a rotating barrel style carburettor, with a totally unobstructed through-way at full opening, having no spray-bar, all fuel whether idling or full bore, issues from the one small hole at the engine side of the barrel. The IFM system itself is the manufacturers response to the deficiencies of normal fuel/tank systems which become more of a problem as performances rise. Timed crankcase pressure is fine for remote tanks and violent aerobatic manoeuvres, but the system doesn't pick up so well from idle. Neither of the systems which do have adequate pick-up (pipe pressure or untimed crankcase pressure), provide enough pressure to sufficiently overcome the various 'G' forces which aircraft and boats these days endure, whilst simple suction is out anyway, for any but the most staid of models. (C/L is a special exception). So the IFM device was created. Put as simply as possible, it allows the use of the favoured timed crankcase pressure system but overcomes that method's disadvantage of poor pick-up, by arranging that the fuel supply is also regulated by the varying pressures obtainable (as rpm varies) from the exhaust system. The dual action valve which does this, is the unit fixed to back of the crankcase and comprises several small delicate parts (including the destroyed '0' ring) which demand some care in reassembly. Uniquely this valve allows the two quite separate pressure systems to interact (even oppose each other), so that the fuel supply finally delivered to the carburettor is quantitively (correct throughout the range. That's not easy l Anyway it's effective, as several competitors can testify and it has certainly added much to the overall reliability of the motor/fuel system. During this test it gave no trouble; apart from causing the writer some confusion as to where all the pipes were going and why. The literature provided with the engine gives the necessary information however. The system was used throughout the test except for the few hi-nitro runs, where, due to the small jet size of the AMC carburettor and the designed-in restricted top-end pressure of the IFM system -not enough fuel could be pushed through (even when the needle valve was fully open) to satisfy the greater liquid fuel requirement on higher nitro. Here, therefore, reversion to standard crankcase pressure gave the extra fuel required. *(but not good fuel atomisation, I now understand that this lead to an unexpected low increase in RPM in this configuration, Ashley, Dec 2000).*

Summary

It may be felt that the presence of the manufacturers team during whole of this two-day evaluation period placed certain pressures on the tester. In fact they provided welcome support during a quite intensive test period, and their assistance helped towards validating some of the results What is very certain is that all were a little wiser at the termination because it seems impossible to conduct any tuned pipe tests without learning something, sensitive and responsive as these devices are to quite small changes. Equally this report may seem somewhat laudatory well yes, that's what can happen when faced with a praiseworthy product. It has been a little awkward for the writer, in this first of a new series of engine tests, to contend with possible charges of 'jingoism' which over reporting could bring, set against the unfairness of understating the case. So then, one is drawn to the US idea of 'telling it like it is.' After all some products are going to be at the top ...why not this one? It certainly would have been earlier had he subject of this first report been of a less exceptional product; and it's fortunate indeed that its competition results are speaking strongly also. Here, it's possible that lack of sheer numbers plus the generally retiring nature of its commercial presentation are the major reasons inhibiting a larger dominance of the R/C 60 scene.

As to the specifics of the motor itself, as befits a quality machine it was virtually unscathed even after the 72, 10 minute fuel runs. There was some evidence that the unusually large amount of heat generated at that time was unsettling the liner a little; after all, this part had already 'settled down to the normal cooler five per cent brew by the time of the final fuel onslaught on it. No surprise then at evidence of slight thermal distortion 'out of round.' The writer doubts there are many motors around which have been run on both 72 per cent nitro with ten per cent propylene oxide, and a fairly restrictive quiet tuned pipe at the same time. To explain then, these last few runs were in part a tentative push toward a test to destruction but with no success. Proof thus displayed of the motor's thermal resistance and strength. I must be clear that normal operation would result in considerable longevity. Certainly the modeller seems very well served these days with the various optional hard liner coating materials giving superior service, and it will be instructive to see which of several methods becomes the final No.1 choice. If ingenuity and effort are to count for anything then this quality machine is entitled to the further successes which surely will come this way and this could easily be a consequence of the high reliability which has been acknowledged by successful users. A final point is to reflect on the fact that the motor often finds itself ranged against rear disc/rear exhaust/even .90cu.in. opposition; against which in the boat multi field several creditable placings have been reported.

Operating thus with one hand fettered, could one muse then on the possibility of a full racing version? (a full racing version was produced with rear induction, rear exhaust, 'what a motor' but time ran out before it reached competitive running, Ashley).

Performance

Max BHP 2.9 at 19,000 rpm (quiet pipe), 50 per cent nitro/Carburettor removed)

2.28 at 16,600 rpm (quiet pipe 5 per cent nitro)

1.68 at 17,600 rpm (open exhaust 5 per cent nitro)

Maximum torque

164oz.in. at 15,600 rpm (quiet pipe 50 per cent nitro/carburettor removed)

148ozin at 14.800 rpm (quiet pipe 10 per cent nitro)

111ozin at 10.900 rpm (open exhaust/5 per cent nitro)

RPM standard propellers

11 x 7 1/2 Zinger -14,200 (quiet pipe at 14,!4in./5 per cent nitro.)

11 x 7 1/2 Zinger -14,200 (quiet pipe at 14,!,in./5 per cent nitro)

10 x 6 Grish Nylon -16,920 (open exhaust/5 percent nitro)

Performance equivalents:

BHP/cu.in.. .... 4.77
BHP/cc .... .29
Oz. in./cu.in. 270
Oz.in./cc 16.48
Gm.metre/cc........................11.66

BHP/lb ....,,,......... 2.44

BHP/Kilo 5.39

BHP/sq. in. frontal 414

Manufacturer. Fisher Engineering, 49. High Street, Beighton, Sheffield.