FOX 40 BB

ENGINE ANALYSIS No 116

by R. H. Warring

THE FOX 40 BB is a real "man's" engine specifically developed for rat racing and to the maximum displacement permitted by the AMA Rat Race Rules. Like all Fox engines it has a general look of ruggedness and honest model engineering, despite an overall "gold plating" externally applied as a further distinguishing feature. This, in fact, only serves to emphasise rather than mask the "engineering" finish of the castings on what is essentially a "workhorse" of a power unit rather than a sleek production for mass appeal. Performance-wise the Fox 40 BB is quite capable of speaking for itself, almost literally by its noise level, and by power output.

Although essentially a specialist engine for the more enthusiastic modeller the Fox 40 BB is by no means difficult to handle. The fantastically large induction port coupled with complete absence of effective suction demands a pressure fuel feed (or gravity feed for bench running), but starting characteristics are very good. With a pressure tank, starting from cold can usually be accomplished in two or three flicks at the most, following a generous prime. Restarting with the engine hot is almost immediate without priming.

With a gravity feed setup for bench running flooding is a distinct possibility unless provision is made to shut off the fuel supply until a moment or two before starting (and immediately on stopping again). The most satisfactory answer in this case is a tap in the fuel line or a pinch type clip used on flexible (neoprene) fuel tubing and a similar device is, in fact, recommended by Fox for inserting between the pressure tank and the spray bar in a typical model installation.

Closing the fuel line then prevents any possibility of flooding the engine when refilling the tank at pit stops.

Like a good many "racing" glow motors designed to run on high-nitro fuels the Fox 40 BB is pretty hard on plugs. Long reach plugs are specified and it is very much a matter of finding which particular plugs will stand up best to the fuel being used. On low-nitro fuels plug life is fairly reasonable but with high nitro fuels a plug blown per run is not unusual, although having found a plug which will stand up to a run or two it will usually last for some time. The surest way of blowing a plug seems to be leaning the mixture right out for absolute peak performance. The power loss adjusted for a slightly richer setting is negligible and certainly less expensive.

Two handling features we did not particularly like, both relating to matters of detail design. The propeller driver, we feel, is too coarsely knurled and it is difficult to get a tight enough grip on the prop hub. As a consequence we found prop slipping relatively common when starting. The other "fault" lies in the needle valve which is somewhat difficult and almost painful to adjust (with adequate spring locking tension) due to the small knob.

Another limitation from the handling point of view is that with the very high power output and almost "explosive" starting certain types and sizes of propellers can only be regarded as unsafe to use with the Fox 40 BB. This, in particular, limited the number of test propellers we felt it safe to use,

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especially as many have by now been subjected to considerable hard wear. Duke Fox also mentions that certain propellers (e.g. the Tornado 8x8) have a habit of shedding blades.

Logical prop sizes for rat racing are 8 x 8 or 8 x 9, which should allow the Fox to turn some 13.000 plus r.p.m. on the ground and reach peak r.p.m. (about 15.500) in the air. Fuel makes quite a difference to performance, the design being more or less “balanced” to a 50 per cent nitro content (e.g. Fox Blast), giving some 1.000 r.p.m. up to a 30 per cent nitro mixture on an 8 x 8 or 9 x 6 prop. The Fox 40 BB, rather surprisingly, starts and runs quite well on a straight methanol castor mixture, although holding nothing like the same peak.

Design-wise the 40 BB follows very much the layout of the earlier Combat Special, and is largely conventional except for the very large square intake with parallel section. The crankcase unit is a single, substantial pressure die casting incorporating the induction tube, cylinder and race housing. Porting is conventional, with a single transfer passage on the left side and a diametrically opposite exhaust opening nearly 180 degrees.

The cylinder liner is of soft steel, extremely thin walled for an engine of this size and with enormous rectangular port openings. Transfer opening almost completely over-laps the exhaust. Both ports are approximately 170 degrees wide and the transfer port is 5/16 in. deep, leaving very little metal carrying the upper part of the liner. The liner is, however, very well supported in the crankcase unit. The liner is held down by six screws through the finned (die cast) head of substantial mass for heat retention, the combustion chamber being contoured in “racing” fashion for most efficient gas flow at some expense, we feel, to increasing the mechanical loading on the glow plug element.

The piston is of cast iron machined away to very thin walls as well as being scalloped on the skirt. Top is flat but with a high, narrow deflector, slightly chamfered to the edges.

The fully floating gudgeon pin is hollow, of hardened steel, with brass end pads. Certainly liner and piston appear to have been taken down to limits of material thickness for lightness and with particular attention given to port development and gas flow.

The ½ in. diameter crankshaft is of steel, hardened over the journal length and crankpin but soft over the forward ¼ in. diameter threaded length and crank web. It is carried on a ½ in. ball race at the rear and a ½ in. roller race at the front, the latter being of the cage less type with the rollers simply retained by end flanges. This permits a minimum diameter housing. The main rear race is also unusual in having rather wide ball spacing. The plain length between the races is only lightly rubbed by the shaft and provides an oil seal.

Shaft port opening is 3/8 in. square, entering a 3/8 in. diameter shaft hole an effective entry area of 0.11 sq. in. Finish over the journal length is ground but showing some evidence of fretting at the race positions after about three hours running. Immediately in front of the journal length the shaft steps down abruptly to ¼ in. diameter on which is formed the castellated key for the prop driver and then the standard thread for the prop nut. Relief of hardness is taken right back to the square front of the ½ in. diameter length so that in a bad crash the front shaft could, presumably, bend instead of break. The crank web is quite thick, but heavily chamfered and cut away for counterbalance. Sharp edges are also taken off on the rear face. Crankpin is 0.215 in. diameter. The connecting rod appears to be a light allow die casting,

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machined around the big end to reduce to a satisfactory clearance size.

The crankcase rear cover is a light alloy pressure die casting attached by four Phillips head screws and sealing on a gasket. The centre is drilled and tapped for a brass pressure nipple fitting.
The spray bar is of brass with a steel needle and integral thimble, the whole unit being a little on the flimsy side for an engine of this size and duty (it is difficult to tighten it up properly without fear of stripping the threads holding the retaining nut, for example). The needle end features the Fox-originated spade protrusion to centre the taper needle against vibration. The propeller driver is of steel, with a shaped hole to lock on the shaft.
A standard nut and washer complete the assembly.

Altogether, the Fox 40 BB is a more or less orthodox design of engine with somewhat exaggerated porting, especially on the induction side, demanding that fuel be fed to the engine rather than be sucked in by it. It relies for its performance on inducting and consuming a vast quantity of fuel, and using it efficiently which is where Fox “know how” comes into play with regard to details that make all the difference. The 40 BB, in fact, exemplifies just what can be done through years of experience and development in the matter of extracting more B.H.P. per c.c. from a basic engine layout and tailoring an engine to a particular requirement; and whilst we may disagree with certain details, results speak for themselves. Relatively few designers other than Duke Fox would have got anywhere near the same figures.

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