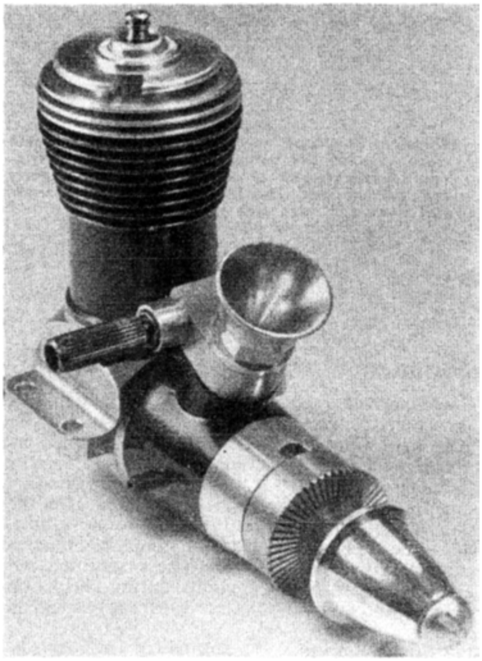


COX SPECIAL .15
Mk II

Third in a new series of regular monthly

ENGINE TESTS
by **Peter Chinn**

Performance *figures and B.H.P. readings taken on straight fuel to conform with F.A.I. rules*

IN view of the new FAI rule extending the obligatory use of standard methanol/castor fuel to the FAI free-flight power class, we shall, in future, be making a point of using standard fuel when testing engines in this category. Accordingly, our report this month on the Mk. II version of the Cox Special .15, includes performance curves obtained from tests using straight 3 to 1 methanol and castor oil fuel.

Development History

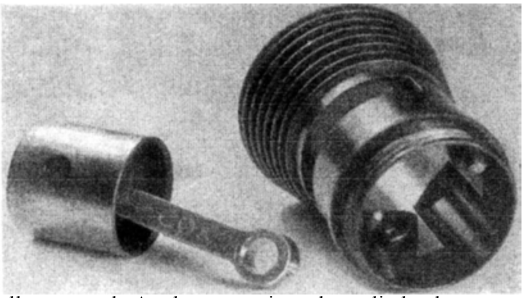
The Cox Special Mk. II is, of course, a development of the Special Mk. I which, in turn, was evolved from the original Cox Tee-Dee 15 engine introduced some five years ago. These engines are unique among contemporary *2.5* cc contest motors in both design and construction. Although the introduction of the Tee-Dee series engines marked a change of Cox policy in so far as they reverted to the use of a shaft rotary valve, many typical Cox features were retained. Thus, unlike any other high performance *2.5* cc glow motor, the Tee-Dee 15 used a machined crankcase (no castings in fact were employed anywhere in the engine), a screw-in one-piece cylinder with twin opposed exhaust ports and internal transfer flutes, and a screw-in head with integral glow filament.

When the Tee-Dee 15 appeared early in 1961, the feature that immediately aroused curiosity was its unconventional crankshaft, bearing and rotary-valve set-up. This was designed during the latter part of 1960 by Bill Atwood, following experiments with rear rotary-valve conversions of the reed-valve Cox Olympic engine, the Tee-Dee's predecessor. Free-flight enthusiasts who attended the 1960 World Championships may recall seeing one of these rear-rotary Olympics impressively performing in the hands of former American National Champion Woody Blanchard.

The Tee-Dee 15 crankshaft was (and still is) by far the largest diameter shaft used in any *2.5* cc engine and thus allowed a very much larger bore gas passage through the shaft, and a correspondingly large valve port. The design of the intake system and front end surrounding the shaft was equally unorthodox. The crankcase, as we have said, is machined—actually it is produced from an aluminium extrusion—and at the front it is formed into an extension sleeve that serves as the crankshaft bearing. A 7/16 in. wide flat is machined across the bearing to a depth sufficient to expose the required intake aperture width. The complete extension is then encased in a black Delrin moulding which includes the threaded boss into which the carburettor venturi is screwed and forms an accumulator chamber between the carburettor and valve port. The moulding is locked in place by an alloy retaining ring screwed onto the front of the bearing.

Largely as a result of this original approach, the Tee-Dee achieved a quite remarkable increase in power compared with the Olympic. Another contributing factor was the revised, high-compression, trumpet-shaped glowhead which replaced the earlier hemi-spherical type. Tee-Dee 15's were quickly adopted by many leading FAI free-flight contestants and, within a few months of the engine's introduction, it had powered the winners of several important contests, including the 1961 World Championships and the 1961 British Nationals. However, the manufacturer also had some less favourable reports to contend with. Firstly, the Tee-Dee had a quite ravenous appetite for glow filaments, when propped and fueled for maximum performance. Secondly, and especially if rpm were taken up beyond the 20,000 mark (unnecessary, admittedly) failure of the piston-conrod ball-joint, or fracture of the cylinder between the ports, would sometimes occur.

Within less than a year the Tee-Dee 15 was, therefore, withdrawn and replaced by a revised model known as the Cox Special 15. This had a new head, a new cylinder and a new piston-conrod assembly. The head was changed to a conical combustion chamber shape and provided with a heavier gauge filament. The cylinder wall thickness was increased by over 70 per cent, and the former hardened steel piston and ball-joint hardened steel conrod were replaced by a cast-iron piston with solid *5/32* in. dia. gudgeon-pin and a machined light



Close-up illustrates new single exhaust port and three large transfer flutes in place of the usual symmetrical arrangement of dual opposed exhaust ports and dual opposed transfer flutes. These effectively reduce exhaust port area by Just over 30 per cent from the Mk. I Special .15.

alloy conrod. At the same time the cylinder bore was increased by .006 in. o take full advantage of the *2.5* cc displacement limit and rotary-valve timing was altered to give earlier opening.

New Cylinder Porting

This Mk. I version of the Cox Special remained in production for three years, finally being superseded by the present Mk. II last summer. This model shows the first major change in Cox cylinder design. In place of the usual symmetrical arrangement of dual opposed exhaust ports and dual opposed transfer flutes, it has a single exhaust port and three transfer flutes. This reflects a current trend in engine design which is towards the further development of transfer systems. The Mk. II transfer system consists of a vertical flute diametrically opposite the exhaust port, flanked by two inclined flutes which converge and almost join the centre one at the top. These flutes extend around approximately 230 degrees of the bore circumference at the bottom of the cylinder, tapering to 180 degrees at the top, and are timed to open and close 65 deg. each side of BDC. Exhaust port timing is unaltered at 70-70 deg. port depth being unchanged, but, since the single port width covers 59 degrees less than the sum of the MK I's two ports, the MK II exhaust port area is reduced by just over 30 per cent.

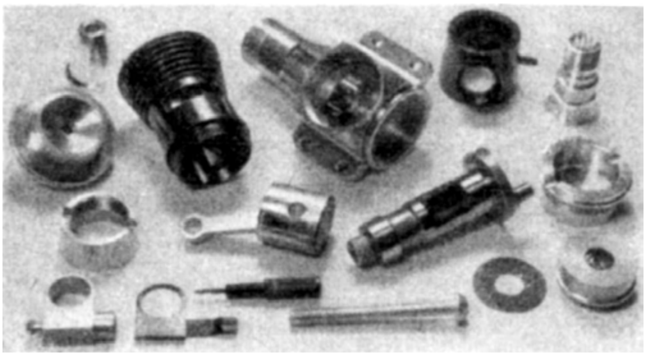
Close inspection reveals one or two other small differences. Our test samples disclosed a very slightly wider valve aperture in the main bearing, as a result of which, rotary valve timing was extended by 5 degrees, i.e. valve timing is now 32.5 deg. A.B.D.C. to 47.5 deg. A.T.D.C. A short oil channel has been added to the main bearing to aid lubrication of the rear section of the shaft and a stamped conrod is used in place of the former turned component.

Performance

As is well-known to most engine enthusiasts, Cox motors are built to extremely close tolerances and do not require a running in period, as such. The makers merely recommend that the engine be run rich for the first 60 seconds, after which it may be given its head. A slight improvement in power can be expected after the engine has accumulated about 30 minutes running time. Our test engine was given a total of about 60 minutes before any tests were undertaken. The engine accumulated a further hour, approximately, during checks on different fuels and comparisons with earlier models on various props.

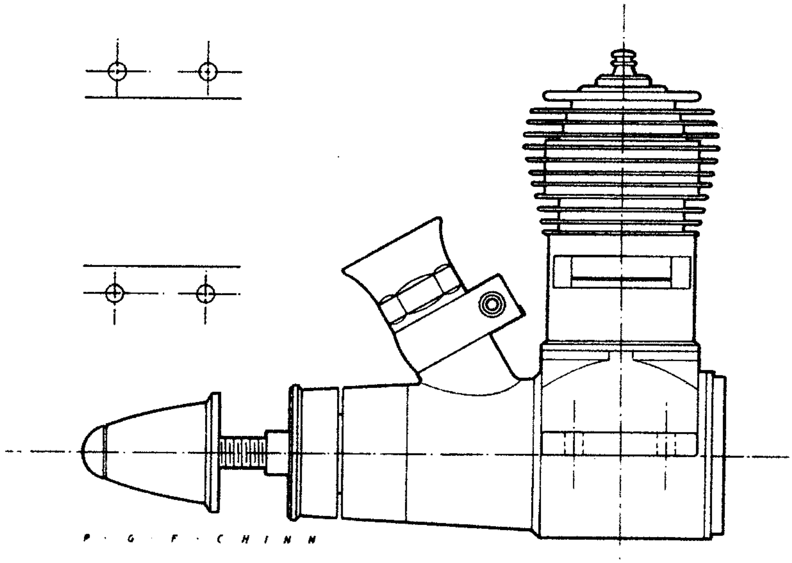
Starting qualities were good and much the same as those of the previous model. Priming *into* the exhaust port produced a quick start when the engine was cold. A single flick of the prop with the intake choked was usually the only preliminary necessary for a hot restart. The MK II was not the most vibration-free *2.5* glow we have encountered, nor were rpm and torque readings held exactly rock steady on straight fuel. These engines are, however, intended primarily for operation on fuels containing at least 30 per cent nitromethane, and, on such fuels, the improvement in steadiness was most marked. In addition, of course, substantially more power is liberated on a 30 per cent nitro fuel—by our test some 26 per cent more in the case of the Mk. II.

Nevertheless, the output of the MK II on straight fuel was very good, reaching approximately 0.38 bhp at just on 19,000 rpm. Incidentally, it occurred to us that a slight improvement might be achieved—for the purposes of' ultimate contest performance—by reverting to the old Tee-Dee trumpet type head. Unfortunately, our own small stock of these was exhausted in earlier Tee-Dee tests and, in response to our enquiry, the Cox Company informed us that they themselves no longer



Parts of the Cox Special displayed at left give a good indication of the high finish and good design thought in all Cox engines, note that large shaft transfer port and squish band, machined head with integral glow element.

FULL SIZE DRAWING FOR CONSTRUCTIONAL INFORMATION EXHAUST PORT ONE SIDE ONLY.



possessed any stocks of them. It is conceivable, however, that since the choice of plug filament and compression ratio are, to sonie extent, dependent on fuel used, the development of a special head for FAT use might be worthwhile. Compared with the best of our Tee-Dees on straight fuel, maximum torque of the Mk. II was quite a bit lower, but ultimate power output was equally as good by virtue of the MK II's better breathing at high rpm and its higher peaking speed.

To achieve this output in flight, the MK 11 must not, of course, be overpropped. A fast 8 x 4 (around 16,200 rpm static) is certainly the biggest practical prop size and prop dimensions are likely to be quite critical: one might, for example, suggest starting with 8 x 4, 8 x 3¾, 8 x 3½ and 8 x 3 props, and, by flight rests, finding the best climb by cropping blades 1/8 in. at a time.

Although Cox make simple exhaust mufflers for their small engines used in ready-made models, manufacture of units suitable for this larger engine has not yet been undertaken. However, to conform to SMAE requirements, a suitable expansion chamber type silencer is available from Henry J. Nicholls & Son Ltd., at about 25s.

Power/Weight Ratio (as tested): 1.36 bhp/lb.

Specific Output (as tested): 152 bhp/litre.

SPECIFICATION

Type: Single-cylinder air-cooled two-port two-stroke cycle with single exhaust port and triple transfer flutes. Shaft rotary-valve induction. Glowplug ignition. Plain bearing.

Bore: 0.591 in. **Stroke:** 0.556 *in.*

Swept Volume: 0.1525 cu. in. 2499 c.c.

Stroke/Bore Ratio: 0.941:1

Weight: 4.45 oz.

General Structural Data

Crankcase and main bearing machined from extruded aluminium bar, anodised gold. Hardened and ground steel *crankshaft* with full disc web and crescent counterbalance, 0.437 in. dia. divided main journal, 0.300 in. bore gas passage and 0.156 in. dia. crankpin. Shaft end knurled for pressed-on gold-anodised *prop driver* and tapped for *prop retaining screw*. Unhardened steel *cylinder* with integral fins and blued finish. Cast-iron, flat crown *piston* with solid 0.156 in. dia. *gudgeon-pin* located in piston by pressed-on distance pieces between connecting-rod and piston skirt. Stamped aluminium alloy *connecting-rod* with unbushed eyes. Screw-in aluminium alloy *glow-head* seating on soft copper gasket, Moulded Delrin *main bearing housing* and carburettor boss with moulded-in nipple for optional high-pressure crankcase pressurized fuel system. Screw-in machined aluminium *carburettor venturi* having three surface jets fed via separate *needle-valve body* with steel thread insert for blued steel needle-valve. Needle-valve body reversible for left or right hand installation. Beam mounting lugs.

TEST CONDITIONS

Running time prior to test: 2 hours

Fuel used: 75 per cent IC]. Methanol, 25 per cent Duckhams Racing Castor Oil.

Air Temperature: 68 dog. F.

Barometer: 3030 in. Hg.

Silencer Type: Nil. (Maker does not offer silencer for this model).