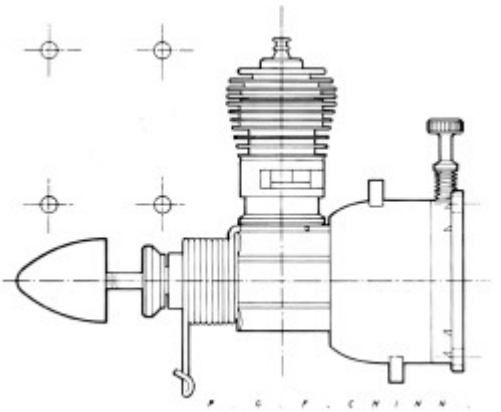
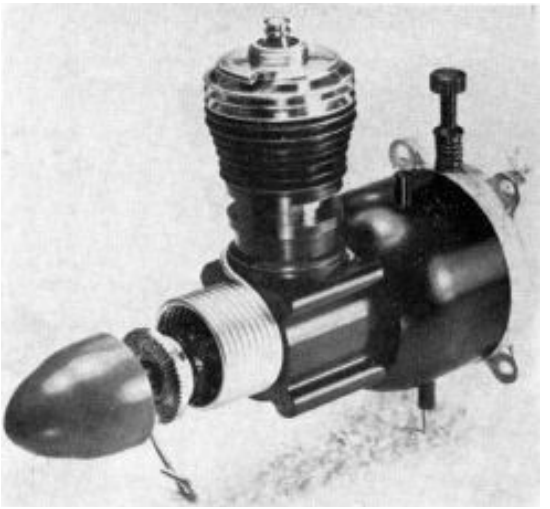


ENGINE TEST

by Peter Chinn

COX BLACK WIDOW



THE COX 'BLACK WIDOW' is the latest and most powerful derivative of the American Cox 'Babe Bee' .049 cu. in. (0.82 c.c.) glowplug engine of which millions have been produced and which, through its wide use in ready-made plastic models, has been responsible for introducing more youngsters to the fascination of the miniature two-stroke engine than any other motor.

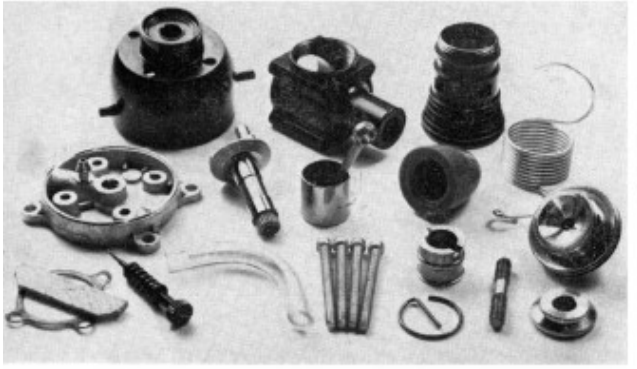
In presenting this new variation on the Babe-Bee theme, the L. M. Cox Company's objective was to offer an engine better suited to regular aeromodelling applications, with particular emphasis on small control-line stunt and combat models. The engine has therefore been given a larger fuel tank and has a different cylinder with twin transfer ports for extra power. It is not, of course, as powerful as the more expensive 'Tee-Dee' .049 rotary-valve contest engine, but does show a useful improvement over the Babe-Bee and Golden-Bee.

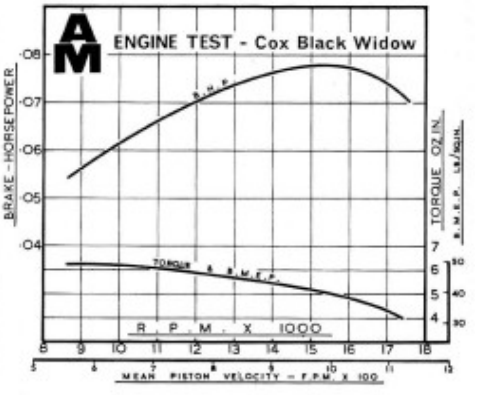
Outwardly, the Black Widow is easily distinguished by its black anodised crankcase and fuel tank. In most respects, however, its design follows that of the Bee models. The engine is of the reed-valve type and the entire induction system is contained within a radial tank-mount.

The tank backplate, which also has four lugs tor mounting the engine to the fuselage front bulkhead, includes a pressed-in steel thread insert for the needle valve. The fuel inlet to this is through an internal tee, integral with the backplate, which is fitted with a short length of fuel tube. The tube is lined with a fine spiral wire spring to prevent kiriking. Air is fed to the engine from a channel in the rear face of the backplate, through a gauze dust filter and, on picking up fuel from a jet hole below the needle-valve, the resultant fuel-air mixture is conveyed forward through a divergent induction tube in the centre of the tank.

The induction tube is an integral part of the machined aluminium fuel tank (which also serves as the crankcase hackplate) and gas is then admitted to the crankcase through the reed-valve assembly which consists of a thin copper-beryllium X-shaped reed held in place by an internal wire circlip. Four long screws tie the complete tank and induction unit to the engine by means of tapped holes in the crank-case.

The tank backplate, incidentally, is the only casting used in the engine. The crankcase, instead of being cast, is, like other Cox motors, machined from extruded aluminium with an integral unbushed crankshaft main bearing. The shaft is of typical Cox design. It is relieved in the centre to form separate front and rear journals, has a machined-in crescent counterbalance, is tapped for a separate airscrew stud and is case-hardened and ground to a fine finish.





Like other current Cox engines, the Black Widow uses a case-hardened steel piston running in a non-hardened steel cylinder and a ball-joint small-end bearing. So that the cup for the latter remains malleable (for turning over the conrod ball after assembly) only the outer surface of the piston skirt is hardened. The other surfaces of the piston are protected by a coating of copper before the piston is exposed to the hardening process.

Again, typically Cox, the full length cylinder is machined in one-piece, complete with cooling fins and internal flute type transfer passages and is externally threaded and flanged at its base for attachment to the crankcase. The cylinder is actually the Cox No. 1 type. There are a variety of Cox cylinders, all having the same bore but with different porting arrangements to suit the various models in the Cox range (Bee, Medallion, Tee-Dee, QZ etc.). The No. 1 type features twin transfer channels and deep exhaust ports allowing a measure of sub-piston supplementary air induction. According to our measurements, it gives the Black Widow an exhaust period of 132 deg. of crank angle, a transfer period of 108 deg. and a sub-piston period of 50 deg.

The Cox glowhead, combining the functions of cylinder head and glowplug, screws into the top of the cylinder and seats on a soft copper gasket. It is of the standard hemispherical pattern, rather than the high performance trumpet type used by the Tee-Dee 049.

Performance

Like the other Cox reed-valve engines, the Black Widow is equipped with a starting device. This fits over the crankcase nose and consists of a coil spring anchored to the base of the cylinder at its fixed end, with its free end shaped to engage the prop when drawn forward. One simply hooks it over the prop blade and turns the prop backwards 1-1$^1/_2$ turns. On release, the engine is then spun vigorously over compression and this can undoubtedly be a help to the raw beginner in obtaining a quick start. The Black Widow is quite easy to start by the usual method of simply flicking the prop, but even the experienced modeller will find the spring helpful in ensuring that the engine starts running in the desired direction. One of the characteristics of reed-valve motors is that they run equally happily clockwise or anti-clockwise and it is a common occurrence, when hand-starting one, to find that the engine has kicked back and begun running in the opposite direction. A starter which will spin the engine over two or three compressions will prevent this.

All the small Cox engines call for very little run-fling-in – in fact a total of about five minutes with the needle setting on the rich side is generally more than adequate. We gave our test motor a total of 15 minutes.

The Black Widow is intended for operation on fuels of a medium nitro rating – i.e. about 15 per cent nitromethane. Using such a fuel, our test motor recorded a maximum torque of just over 6 oz.in. at around 9,000 r.p.m. and a peak output of nearly .08 b.h.p. at between 15,000 and 15,550 r.p.m. These are quite good figures for a 'sport' type .049 and are reflected in some useful speeds on various props..

SPECIFICATION

Type: Single-cylinder, aircooled, glowplug ignition two-stroke with reed-valve induction. Plain bearings. Spring starter device. Integral fuel tank.
Bore:; 0.406 in.
Stroke: 0.386 in.
Swept Volume: 0.04997 Cu. In. - 0.8189 c.c.
Stroke/Bore Ratio: 0.951:1.
Checked Weight: 64 grammes - 2.26 oz.

General Structural Data

Crankcase and main bearing unit machined from extruded aluminium alloy bar. Hardened and ground steel *crankshaft* with machined-in crescent counterbalance, 7/32 in. o.d. divided main journal and 7/64 in. o.d. crankpin. Shaft end knurled for pressed-on machined aluminium *prop driver* and tapped for *prop retaining stud.* Special aluminium alloy *prop nut* with push-on soft rubber *safety spinner.* Un-hardened steel *cylinder* with integral fins and blued external finish. Steel *piston,* hardened on skirt surface only and fitted to ball-ended hardened steel *connecting rod.* Screw-in aluminium alloy *glowhead* with platinum alloy ignition coil and seating on soft copper gasket. *Crankcase backplate, reed-valve housing, induction pipe and fuel tank* machined in one piece from aluminium alloy. *Reed valve* of .001 in. copper-beryllium. Pressure diecast zinc alloy *fuel tank backplate.* Complete tank and induction assembly secured to crankcase with four screws. *Starter spring* of .042 in. dia. spring steel wire.

TEST CONDITIONS

Running time prior to test: Approx 15 minutes.
Fuel used: 15 per cent nitromethane, 25 per cent Newton R castor-oil, 60 per cent methanol.
Air temperature: 13 deg. C.
Barometer: 30.30 in. Hg.

The most useful prop sizes with the Black Widow should be 6 x 4 for a control-line stunt or sport and a 6 x 3 or 'fast' 6 x 4 for free-flight although, should the need arise, the engine is capable of turning 7 in. diameter props of 3 to 4 in. pitch, such as one might wish to use for a large 'motor-glider' type model for example.

Prop speeds recorded on test included 10,600 r.p.m. on a 7 x 4 Taipan nylon-glassfibrc, 11,200 on a 7 x 3$^1/_2$ Bartels epoxy-glassfibre, 12,000 on a 7 x 3 TopFlite wood, 12,600 on a 6 x 4 Tornado nylon, 13,000 on a 6 x 4 TopFlite nylon, 13,800 on a 6 x 4 McCoy nylon, 13,900 on a 6 x 3 KeilKraft nylon. 14,000 on a 6 x 3 Tornado nylon, 14,600 on a 6 x 3 TopFlite nylon and 15,500 on a 6 x 4 (nominal) D.C nylon. The Black Widow was also checked on 5$^1/_2$ x 3 and 5 x 4 Tornado nylon props but these took it up to over 16,000 r.p.m. static which probably means rising to 17,500-18,000 in flight and, as the b.h.p. curve indicates, there would be no advantage in propping the engine for more than say, 16,000 in flight. No problems were encountered during the tests of this new Cox model and the original Cox glowhead survived the entire series of test runs.

One final point. As supplied, the Black Widow has the fuel pick-up tube located to suit an anti-clockwise control-line circuit. Purchasers who wish to use the engine for free-flight - or a clockwise circuit - are therefore advised to re-position the pick-up accordingly.

Power/Weight Ratio (as tested): 0.55 b.h.p./lb.
Specific Output (as tested): 95 b.h.p./litre