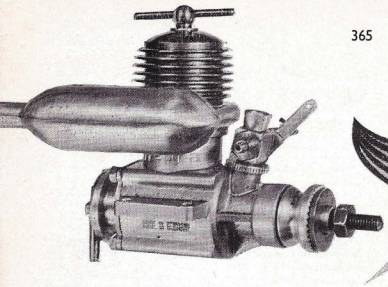
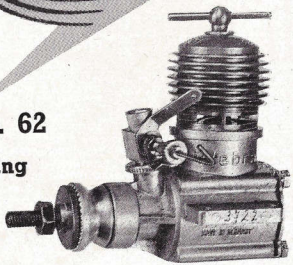


ENGINE ANALYSIS No. 62

by R. H. Warring

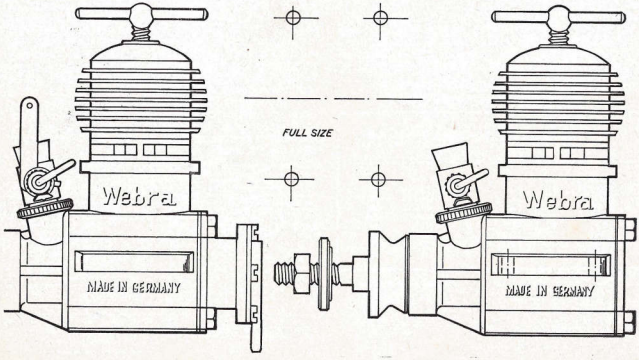


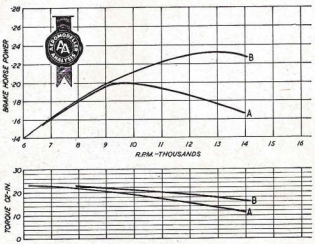
KOMET & BULLY

THE TWO BASIC versions of these engines are identical, except that the "Bully" utilises a bored-out cylinder to increase the swept volume by approximately 1 c.c. The 2·5 c.c. "Komet" (Red head) was submitted as a standard engine. The 3·5 c.c. "Bully" (Blue head) was fitted with a barrel-type carburettor, exhaust unit, and vane-type pump mounted on the rear crankcase for supplying vacuum pressure for radio control servo power. Apart from this, the same general descriptions apply to both engines.

The most surprising feature of the tests was that the "silenced" 3·5 c.c. version appeared to be very strongly affected by exhaust back pressure, realising only a similar power output to the 2·5 c.c. version up to 9,000 r.p.m. and then falling right off. The 2·5 c.c. "Komet" peaked at 13,000 r.p.m. and thus showed an appreciably greater power output than its larger counterpart with silencer unit.

The appearance of the crankcase is that of a ball-bearing engine, nevertheless the bearing is, in fact, plain and simply reamed to size in the crankcase casting. Dimensions are comparatively squat with a chunky, square-looking crankcase, the basic design being quite orthodox throughout with the exception of the propeller shaft. This is a separate length of ·193-in. diameter threaded steel (5 mm. DIN thread with a pitch of ·8 mm.) which screws into the crankcase proper. The end of this extension shaft is slotted to take a screwdriver for tightening up, or removing if broken. *continued overleaf*





The silencer unit as fitted to the "Bully" consists of two identical die-castings, rather like two halves of a toy pistol in shape, which bolt together with two screws. The assembled unit is locked in place by screwing down the cylinder liner when the collector ring effectively encircles the 360 degree exhaust porting on the cylinder. If the unit is mounted the wrong way up, *i.e.*, clamped under the cylinder flange, the port timing is altered. A baffle plate is cast in each half of the expansion area with only two small passage ways for the escape of exhaust gas. The silencing effect is very good indeed, but engine performance suffers appreciably.

The silencer appears to put an abrupt limit to maximum speed running, with the deterioration in performance above about 10,000 r.p.m. very marked indeed. Even with quite small propeller loads a further increase in speed was gained with some reluctance—an 8 x 3 propeller, for example, giving only 12,500 r.p.m. when one would expect a figure approaching 15,000 r.p.m. for an engine of this size. The power curve shows an abrupt peak at 9,500 r.p.m. with exhaust fitted.

There is undoubtedly considerable back pressure from the fitted exhaust, which also tends to make the engine run very hot even in an adequate slipstream. This, in turn, has the effect of producing a marked falling off in power after a matter of 20 seconds running or so.

Response to the barrel-type throttle was extremely good and positive. The engine could be throttled down to a safe minimum "idling" speed of 2,500-2,700 r.p.m. on almost any size of propeller, with immediate pick-up

WEBRA "KOMET" 2·5 c.c. FUEL CONSUMPTION

R.P.M.	B.H.P.	Duration on 1 c.c.	Duration on 10 c.c.	Duration on 15 c.c.	c.c./B.H.P./ per Second
6,000	·14	26:4	4:24	6:36	·27
7,000	·16	24:8	4:08	6:12	·25
8,000	·18	23:4	3:54	5:51	·24
9,000	·20	21:8	3:35	4:49	·23
10,000	·21	20:2	3:22	4:41	·235
11,000	·22	18:7	3:07	4:33	·24
12,000	·23	17:3	2:53	4:20	·25
13,000	·235	15:7	2:37	3:55	·27
14,000	·225	14:3	2:23	3:35	·31

The "Komet" shows a relatively low fuel consumption with a minimum demand at 9,000-10,000 r.p.m. An interesting fact is that both the fuel consumption and power output figures are higher than those of the 3·5 c.c. "Bully" with exhaust manifold and silencer unit—the "Bully", in effect, using a bored-out 2·5 c.c. cylinder.

Propeller—r.p.m and Power curves

(A *represents* 3·5 *c.c. Bully with throttle, silencer and pump.* B *represents* 2·5 *c.c. Komet.*)

Propeller—R.P.M. Figures		
Propeller	Bully with silencer & fuel pump *r.p.m.*	Komet *r.p.m.*
12 x 4 (Trucut)	6,500	
11 x 4 (Trucut)	7,700	
10 x 4 (Trucut)	8,700	8,800
9 x 6 (Trucut)	8,500	
9 x 5 (Trucut)	9,200	
9 x 4 (Trucut)	10,400	10,400
8 x 5 (Trucut)	10,500	
8 x 4 (Trucut)	12,000	13,300
8 x 3 (Trucut)	12,500	
10 x 6 (Frog nylon)	8,200	8,500
9 x 6 (Frog nylon)	9,600	10,000
8 x 8 (Frog nylon)	7,600	
8 x 5 (Frog nylon)	—	11,400

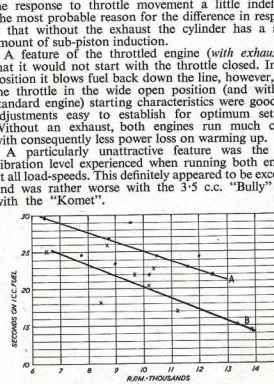
Fuel used: 2 per cent. nitrated, standard diesel mix. *Throttle control.* Fully effective in reducing speed to 2,500-2,700 r.p.m. on engine fitted with exhaust unit. Partially effective only on engine without exhaust unit, reducing idling r.p.m. to approx. 3,000 r.p.m. but fluctuating.

and fast response to throttle movement. The throttle is conventional in form, the brass barrel rotating over a spray bar. The carburettor body is a casting and includes an ingenious solution to provide locking for the hexagonal end of the spray bar so that this cannot rotate accidentally with the barrel if the spray bar is not assembled tight. The bottom of the carburettor body is threaded into the crankcase casting and can therefore be mounted on a standard engine as well. A large knurled ring nut enables the spray bar to be locked at any convenient angle. In the normal right-angled position the forward position of the throttle lever is very close to the propeller disc for manual operation.

The throttle is also effective on the "Komet" (without exhaust fitting) and can be used to produce an idling speed of the order of 3,000 r.p.m. However, at any throttled-down position running is rather erratic and the response to throttle movement a little indefinite. The most probable reason for the difference in response is that without the exhaust the cylinder has a small amount of sub-piston induction.

A feature of the throttled engine (*with exhaust*) is that it would not start with the throttle closed. In this position it blows fuel back down the line, however, with the throttle in the wide open position (and with the standard engine) starting characteristics were good and adjustments easy to establish for optimum settings. Without an exhaust, both engines run much cooler with consequently less power loss on warming up.

A particularly unattractive feature was the high vibration level experienced when running both engines at all load-speeds. This definitely appeared to be excessive and was rather worse with the 3·5 c.c. "Bully" than with the "Komet".



The vane-type pump employed on the "Bully" is of elementary design, consisting of a 12 mm. diameter rotor eccentrically mounted in a 14 mm. diameter housing formed as an extension on the standard backplate. The phosphor bronze vanes 10 x 4 mm. fit into slots in the rotor. The rotor shaft (cut integral with the rotor) extends through the backplate and is riveted to a disc which picks up the drive from a pin fitted into the hollow crankpin (thus enabling the same crankshaft to be used on the standard and "special" engine).

Performance of the pump was measured by a vacuum gauge and proved to be exactly linear with speed. Vacuum pressure generated is virtually nil below 5,000 r.p.m., but from then on increases progressively with speed up to a maximum measured of 2·75 p.s.i. suction at 13,000 r.p.m. Suction available from the pump at peak power (9,000 r.p.m.) is 1·5 lb. per sq. in.

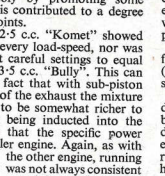
Despite its diminutive size, therefore, the pump is a reasonably efficient working unit although somewhat restricted in performance by the limited operating speed of the engine. We feel that the diameter size of the pump could well have been increased with considerable advantage.

Fuel consumption measurements showed the Webra 3·5 to be extremely lenient on fuel, achieving quite remarkable duration figures for an engine of this swept volume on 1 c.c. of fuel. Minimum lean mixture setting was a little difficult to establish accurately with different propeller loads since the overheating tendency of the engine demanded a rather richer setting at some loads to maintain speed (presumably by promoting some further degree of cooling). This contributed to a degree of "scatter" on the plotted points.

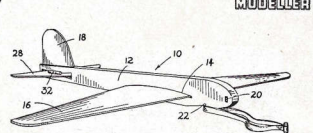
Comparison tests with the 2·5 c.c. "Komet" showed fuel consumption to be up at every load-speed, nor was it possible even with the most careful settings to equal the figures obtained with the 3·5 c.c. "Bully". This can probably be put down to the fact that with sub-piston induction exposed by removal of the exhaust the mixture setting at the carburettor has to be somewhat richer to compensate for the extra air being inducted into the crankcase, and also the fact that the specific power output is higher with the smaller engine. Again, as with the other engine, running was not always consistent on minimum lean needle setting and a slightly richer setting was generally called for to complete a run at a constant speed.

SPECIFICATION

	Bully 3·5 c.c.	Komet 2·5 c.c.
Displacement:	3·416 c.c. (·208 cu. in.)	2·454 c.c. (·175 cu. in.)
Bore:	·6505 in.	·551 in.
Stroke:	·627 in.	·627 in.
Bore/Stroke ratio:	1·04	·88
Weight: Standard engine:	5½ ounces	5¼ ounces
with exhaust throttle and pump:	6½ ounces	
Max. B.H.P.:	(2·5) ·235 BHP at 13,000 r.p.m. (3·5) ·20 BHP at 9,500 r.p.m.	
Max torque: (2·5) } (3·5) }	23 ounce-inches at 6,500 r.p.m.	
Power rating: (2·5)	·069 B.H.P. per c.c.	
(3·5)	·059 B.H.P. per c.c.	
Power/weight ratio: (2·5)	·043 B.H.P. per ounce	
(3·5)	·03 B.H.P. per ounce	
Material specification:		
Crankcase:	Pressure die-cast light alloy	
Cylinder:	Hardened steel	
Cylinder jacket:	Light alloy anodised, red "Komet" or blue "Bully"	
Piston:	Cast Perlite iron	
Contra-piston:	Hardened steel	
Crankshaft:	Hardened steel with extension screw	
Connecting rod:	Forged dural	
Main bearing:	Plain	
Sprayber assembly (and barrel throttle):	Brass	
Exhaust unit:	Pressure die-cast light alloy	



DIMENSIONS IN MILLIMETRES



IMPORTANT PATENTS

2820322 F. H. WHITE *Application date* 25/5/56

THIS INVENTION provides a catapult launched glider in which the well-known trimming difficulties which are associated with high speed launch are tackled in a novel manner. The entire tailplane is pivoted in an eccentric slot through which it passes and supports a small closed tube at its pivot point, containing a free ball weight. During launching and while in an "ascending" attitude, the tailplane assumes a normal attitude; when the nose drops the forward movement of the weight in the tube tilts the tailplane in its slot to raise its trailing edge into an elevating position.

Constructionally the Webras feature a robust crankcase die-cast in light alloy with screw-in cylinder. Exhaust ports are cut in the cylinder flange and four narrow transfer ports are milled on the inside of the cylinder, tapering at the top end and overlapping the exhaust almost completely. The piston is of cast iron with a relatively thick wall around and above the gudgeon pin. Piston top is conical.

The light alloy connecting rod appears to be a dural forging with a ·155-in. (4 mm.) little end and ·197-in. (5 mm.) big end bearings finished by reaming. The silver steel gudgeon pin is a tight fit in the piston.

The hardened steel crankshaft is ·354-in. (9 mm.) diameter, ground to taper immediately in front of the bearing and finishing short in the light alloy propeller driver. It appears a little on the small side, rather emphasised by its stubby length. The crank web is rather crudely finished. The crank pin is hollow (·098-in. hole) and takes a stud to extend its length when fitted to the "special" to engage the rear disc driving the vacuum pump rotor.

The general standard of workmanship and finish is good and the running fits just about right. Although both engines showed signs of overheating whilst running, in both cases the main bearing ran cool.

Webra 3·5 c.c. Bully Pump efficiency