A TYPICALLY THOROUGH engineering job, as is only to be expected from a German manufacturer, the 3.6 c.c. "Bison" fits a popular control line and radio control demand and is supplied with a throttle unit with the latter use in mind. Of orthodox design and construction, the "Bison" proved to be an exceptionally easy engine to handle whilst at the same time capable of a good power output, peaking at just over .3 B.H.P. at 13,000 r.p.m., which is a moderate performance for a long stroke engine of this type and size (actually considerably oversize from the nominal 3.5 c.c.).

Probably the most likeable characteristic is that although it is a 3.5 c.c. engine it could equally well be rated as "suitable for beginners" for ease of starting, following either finger choking or priming through the exhaust. Its least attractive feature is its tendency to vibrate quite badly at all load speeds, particularly in the 10-13,000 r.p.m. range, where it would normally be employed for radio control work. Although a slow motor, we estimate its vibration to be at least as much as any 3.5 c.c. diesel, and probably more.



With throttle and exhaust fitted, the Bison presents a workmanlike appearance.

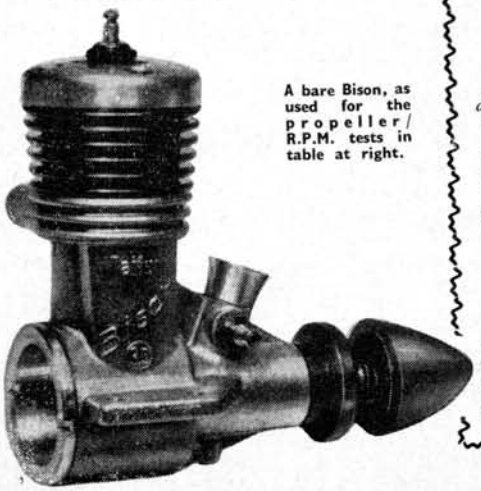
ENGINE ANALYSIS No. 83 by R. H. Warring

Two throttle equipped engines for R/C

The throttle unit comprises a conventional barrel fitted around the spraybar in a spherical "swelling" on the intake tube, this complete unit plugging into the stub intake in the crankcase casting and securing with a screw. For ordinary running it can be replaced by a short venturi insert held in place by the spraybar assembled through the hole in the stub intake. The lever connecting to the barrel throttle is linked to a pivoted exhaust blanking plate which rotates to shut off the exhaust opening completed in the "closed throttle" position. The linkage is well engineered and positive in action with minimum friction. "Low throttle" position is given by forward movement of the linkage which brings it extremely near the propeller arc—only just missing. In the most forward position, too, the barrel is far from completely closed, accounting for the rather high "low speed" r.p.m. figures. We found that the throttle control gave a reduction to speed from 10,000 to 6,000 r.p.m. with a Frog 9 x 6 nylon propeller; and from 12,500 to 6,500 with a Frog nylon 8 x 4 propeller. Lower speeds could only be achieved by "mutilating" the linkage to get the barrel to close more fully.

Most response to throttle came over the latter part of the movement and was quite smooth. Pick up from low to high speed again was fairly rapid, but with a certain hesitation, whilst the mixture readjusted itself after running for any time in the "low" position. Running was strong and consistent at "low" setting, but the speed was fairly high and the low speed mixture relatively lean.

For normal high speed running, fitting of the throttle produced a penalty of 600 r.p.m. at 10,000 r.p.m. and approximately 1,000 r.p.m. at higher speeds. Corresponding r.p.m. figures for the two propellers mentioned above, running with the short venturi insert replacing the throttle unit and conventional spraybar were: 9 x 6—10,600 r.p.m.; 8 x 4—13,600 r.p.m. All power test figures were conducted with the basic arrange-



A bare Bison, as used for the propeller/R.P.M. tests in table at right.

TAIFUN BISON 3.6 c.c.

PROPELLER—R.P.M. FIGURES

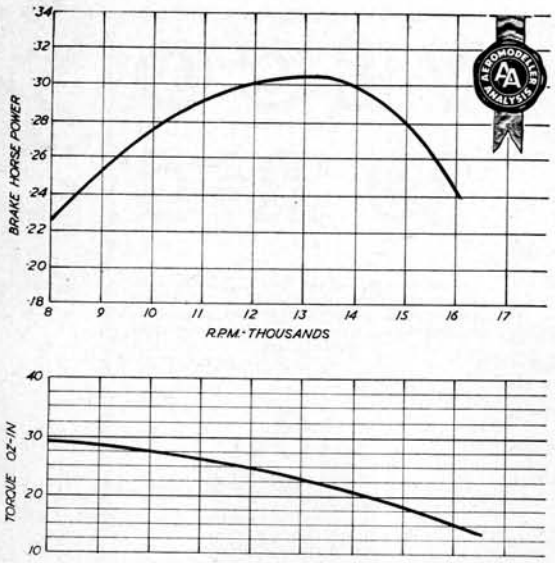
dia. x *pitch*		*r.p.m.*
9 x 6	Frog nylon	10,600
8 x 4	Frog nylon	13,600
8 x 4	Top Flite nylon	14,400
8 x 6	Top Flite nylon	11,300
9 x 4	Top Flite nylon	12,100
9 x 6	Top Flite nylon	10,000
10 x 3½	Top Flite nylon	10,300
9 x 4	K-K nylon	12,500
9 x 6	K-K nylon	9,500
8 x 6	K-K nylon	12,000
8 x 4	K-K nylon	14,200
9 x 6	Semo nylon	10,200
9 x 4	Semo nylon	11,400
8 x 6	Semo nylon	10,300

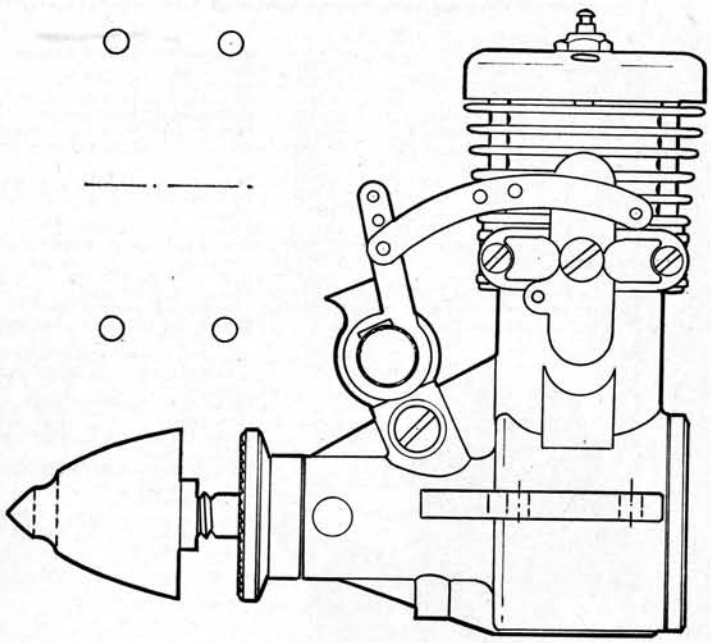
Fuel used: standard glow fuel mixture plus 7 per cent. nitromethane.

Note: all propeller r.p.m. figures quoted are for the "Bison" running with normal intake tube and spraybar.

SPECIFICATION

Displacement: 3·629 c.c. (·2214 cu.in.)
Bore: ·631
Stroke: ·708
Bore/stroke ratio: 0·89
Bare weight: 6 ounces
Max. Power: ·304 B.H.P. at 13,300 r.p.m.
Max. torque: 30 ounce-inches at 7,500 r.p.m.
Power rating: ·084 B.H.P. per c.c.
Power/weight ratio: ·0507 B.H.P. per ounce
Material Specification:
Crankcase: light alloy pressure die casting
Cylinder: mild steel (unhardened)
Cylinder jacket: turned dural anodised black
Cylinder head: turned dural, polished
Crankshaft: hardened steel, 6 m.m. DIN propeller shaft thread
Connecting rod: light alloy forging
Piston: cast iron
Spraybar: brass
Throttle unit: brass spraybar and barrel throttle; brass linkage to pivoted exhaust cover plate
Propeller driver: dural, anodised black (collet fitting)
Back cover: turned dural
Spinner nut: turned dural, anodised black
Manufacturers:
Johannes Graupner, Kirchheim-Teck W. Germany





Power curve and actual size drawing

ment and thus the throttled engine could be expected to give an appreciably lower performance, particularly at the high speed and probably peaking at around 11,500-12,000 r.p.m.

Constructionally the "Bison" features a substantial die-cast crankcase unit incorporating the low cylinder housing and stub exhaust on the post side. The mounting lugs are very strong and carried round the front of the crankcase. The transfer passage, opposite to the exhaust is cast in leaving a relatively large passage outside the cylinder liner. Provision is made to drill and tap a "slug" in the bottom of the crankcase under the shaft port for port-controlled pressure take-off.

The cylinder liner is of soft steel, plain in shape with a small flange at the top. Exhaust and transfer ports are cut through the walls, diametrically opposed, the transfer overlapping the exhaust by approximately 70 per cent. The fins are a separate light alloy turning, anodised black and simply sliding in position up the outside of the cylinder. Small nicks on the top flange of the cylinder act as location marks to align the cylinder relative to the holes bored in the jacket for the holding down screws and, in fact, are actually necessary to clear the screws. This does appear a rather unnecessary complication on a mass production job.

The cylinder liner is finished by grinding all over and the bore is finally finished by honing. The piston is of cast iron, ground to finish, and is purely cylindrical in form with a flat top and simple flat plate deflector on the transfer side. Walls are left relatively thick and the piston is a little on the heavy side. The .157 in. diameter fully floating gudgeon pin is hollow and fitted with aluminium end pads. The size of hole drilled through the gudgeon pin is so small that there is virtually no weight saving in making it hollow and so presumably the main reason for making the pin hollow is to accommodate the end pads.

The cylinder head is turned from dural with a plain (unfinned) top and incorporates a contoured combination chamber top. The glow plug is centrally located and of conventional form, with a 1½-volt element.

The connecting rod is a very nice light alloy forging, quite light yet exceptionally rigid. Big and little end bearings appear to have been reamed and honed and are a very good fit without "rock" on the crankpin and gudgeon pin, respectively.

The crankshaft is $\frac{3}{8}$ in. diameter stepping down to .256 in. diameter in front of the bearing and then cut with a 6 mm. DIN thread (.232 in. diameter). The intake port is rectangular in shape. The thick web incorporates a counterbalance, whilst the .215 in. diameter crankpin is drilled through. The shaft is hardened and ground between two centres over both diameters. The crankpin is also ground to finish.

The main bearing consists of a substantial bronze bushing inserted in the crankcase casting, this bush having a wall thickness slightly over $\frac{1}{16}$ in. A narrow oilway is channelled down the bearing for about one half of its length, whilst notches at the end of the bush provide oil entry ways.

The dural propeller driver is fitted on a split collet to locate on the front diameter of the crankshaft. A spinner nut is employed, with a protruding spigot slightly over $\frac{1}{16}$ in. diameter calling for propeller hubs to be drilled out—a feature we always view with some disfavour.

The back cover is a simple dural turning which screws into the back of the crankcase, sealing against a thin gasket.

Workmanship throughout is first class, with an excellent piston-cylinder fit but, rather surprisingly, a very slack fit on the main bearing equivalent to a substantial clearance at the front end. This is not harmful and in view of the fact that the bearing itself is bushed should not affect the life of the bearing. The shaft, in practice, only really "rubs" at each end of the bush.

Summarising: a very pleasant engine to handle and one which gives a consistent, good power performance without being outstanding in this respect. The vibration level is high and the engine itself a little on the heavy side—but it is really robust and well built.