



The FROG 349

“one of the most technically interesting diesels to appear . . . for a long time. . . .”

THE new Frog 349 is one of the most technically interesting diesels to appear from a British manufacturer for a long time. Its design, particularly the form of induction valve used and its unique type of cylinder porting, lifts it right out of the rut. Its appearance is equally distinctive.

It is also, we would say, an engine which one should not judge too hastily on first acquaintance. Most model engines improve during the first hour or two of running. This, to judge from our test example, applies to the Frog not only in regard to power output, but also in respect of handling and running characteristics in general. Further comment on this follows under the sub-heading “Performance.”

Two models of the 349 are currently offered, the only difference between them being in the main bearing employed. Both engines are fitted with Vandervell sintered bronze bushes, but in the more expensive model (as chosen for our test), this is supplemented by a ball journal race at the inner end. Externally, the engines are distinguished by the finish of the castings: matt grey for the ball bearing model and tumble polished in the case of the plain bearing engine.

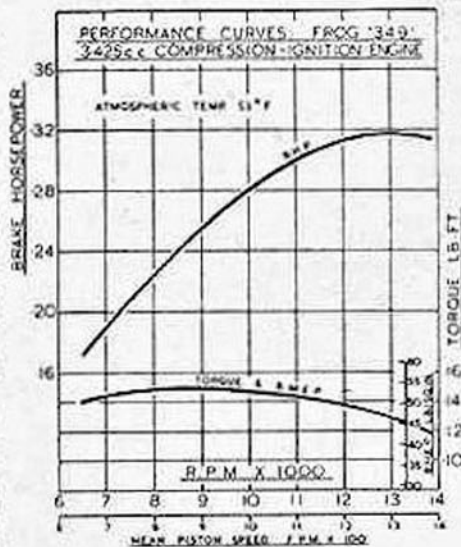
The 349 is assembled around a neat pressure casting comprising crankcase, main bearing housing and lower cylinder block section. Substantial mounting lugs are positioned symmetrically on the horizontal centre-line and the bearing housing is webbed both vertically and laterally. The cylinder liner has a heavy flange, $\frac{1}{4}$ -in. deep, which fits closely within the top of the main casting and is located vertically by a suitable seating. The divided exhaust port is cut through this flange, while the inclined, circular section transfer ports, five in number, are

drilled at an angle to pass through both the skirt section of the cylinder and the lower part of the flange. While this porting arrangement is, in many respects, quite unique, it is interesting to note, in passing, that the use of a flange encompassing the full depth of the exhaust, with the transfer cut into its lower face, is, in fact, shared by two other recent loop-scavenged engines from widely separated corners of the globe, namely, the American Fox 15 and the current version of the Japanese O.S. Pet 09. This similarity can only be coincidental, as all three engines were designed at about the same time and none of the designers responsible could have been influenced by the work of either of the others.

The upper section of the liner is surrounded by a close-fitting machined cooling barrel and is topped by a finned alloy head. Four long Phillips head screws pass through the head and barrel and into deep lugs in the crankcase to secure the cylinder assembly. An unusual refinement here is the exhaust seal. This consists of a nylon gasket between the top of the cylinder liner flange and the base of the cooling barrel, which expands under the pressure of the cylinder holding down bolts and effectively confines exhaust gas and residual oil to the exhaust duct. The duct has sufficient material at the ends to facilitate the fitting of an extension pipe or exhaust throttle unit for R/C.

The crankshaft is relieved in the centre to provide, in effect, two $\frac{3}{8}$ -in. dia. journals and is drilled and tapped for a $\frac{1}{4}$ -in. replaceable prop stud. This latter is of high tensile light alloy, an arrangement which should give added protection against damage in the event of a crash. The crankpin has a small spigot extension which engages the valve rotor.

This latter is another unique feature of the 349. It consists of an open ended cylinder, $\frac{3}{8}$ in. in diameter and $\frac{1}{8}$ in. long, sealed by a $\frac{3}{8}$ -in. dia. disc at the front end, the whole being machined in one piece from steel. The cylindrical portion of the rotor has a $\frac{1}{4}$ -in. dia. admission port and the periphery of the disc



is slotted at the appropriate point for the crankpin drive. The rotor is carried in a diecast light alloy housing which also forms the crankcase backplate and carburettor unit. Mixture is conveyed from the down-draught carburettor, into the open end of the rotor and thence upwards, into the crankcase, through the rotor port and an aperture formed in the rotor housing.

While the Frog 349 is neither the lightest nor the smallest $3\frac{1}{2}$ -c.c. diesel at present on the market, it is a compact design of attractive appearance and robust construction and should become popular among C/L and R/C enthusiasts.

Specification

Type: Single-cylinder, air-cooled, loop-scavenged two-cycle, compression ignition. Rear drum valve induction with sub-piston supplementary air induction. Conical pistons crown.

Bore: 0.666 in. Stroke: 0.600 in. Swept Volume: 0.209 cu. in. = 3.425 c.c.

Stroke/Bore Ratio: 0.901 : 1.

Weight: $6\frac{1}{2}$ oz.

General Structural Data

Crankcase/main-bearing unit and rear housing of pressure diecast LAC.112A alloy. Plain disc web crankshaft of Phoenix case-hardening steel, case-hardened and tempered and running in one $\frac{3}{8} \times \frac{7}{8}$ -in. E.L. series ball journal bearing, supplemented by Vandervell sintered-bronze steel-backed bush. Brico cast-iron piston running in Phoenix steel cylinder, case-hardened and tempered. Drop-forged RR.56 alloy connecting-rod. Full floating $\frac{3}{16}$ -in. dia. solid gudgeon-pin. Contrapiston of mild steel. Machined alloy cooling barrel and separate die-cast LAC.112A cylinder head with nylon thread lock for compression screw.

Test Engine Data

Running time prior to test : 4 hours.

Fuel used : Shell Pow-Mix (nitrated).

Performance

A full four hours of running-in were given to our test engine and the all-round improvement towards the end of this period was most marked. During the first hour or two there was a power loss, amounting to 15-20 per cent., as the engine warmed up. This is by no means unusual

among diesels and, in the case of the 349, the makers state that this is primarily due to the nature of the Vandervell main bearing employed. Even as this tendency wore off, however, the 349 continued to run somewhat unevenly, demanded frequent control readjustments if required to run for more than two or three minutes continuously and, in general, sounded somewhat less than happy.

But for the fact that we had already had experience of the 349 prototype some 18 months previously, we might have been tempted to begin our assessment of the 349 at this point, especially as "big" diesels are invariably rather harsh running and lack the high specific outputs of the smaller diesels of up to $2\frac{1}{2}$ c.c. Prototype tests had, however, shown the design as having pleasant handling characteristics and consistent running qualities and some further running was, therefore, given to the production model in the expectation that a further improvement would eventually be realised.

Such an improvement did, in fact, become evident between the third and fourth hour. At the end of this period, the engine was given a continuous run of 12 min. on a $9/4$ PAW Trucut prop and held a steady 12,400 r.p.m. without read-

justment to the controls, apart from the usual slackening off of the compression setting during the first minute of warming up.

On the reaction dynamometer, the Frog now began to demonstrate a useful performance. Torque rose to a maximum figure of 0.15 lb. ft. equivalent to a b.m.e.p. of 55 lb./sq. in., at 9,000 r.p.m., and declined steadily to give a maximum b.h.p. of 0.318 at 13,000 r.p.m. Cold starting was reasonably good, if not exactly in the beginner class, and rapid re-starts were obtained easily with the engine warm.

Controls were easy to adjust and held settings firmly. The nylon compression lock is very effective and there was no tendency, at any time, for the contra-piston to seize.

To sum up, the Frog 349 appears to be an engine that will "grow" on its owner. There have been more poor large diesels than good ones, but the Frog definitely belongs to the latter group. It has plenty of power (it is, in fact, the most powerful British $3\frac{1}{2}$ -c.c. diesel available at the moment), is well built, attractive to look at and, last but not least, very reasonably priced.

Power/Weight Ratio (as tested): 0.75 b.h.p./lb.

Specific Output (as tested): 93 b.h.p./litre.

