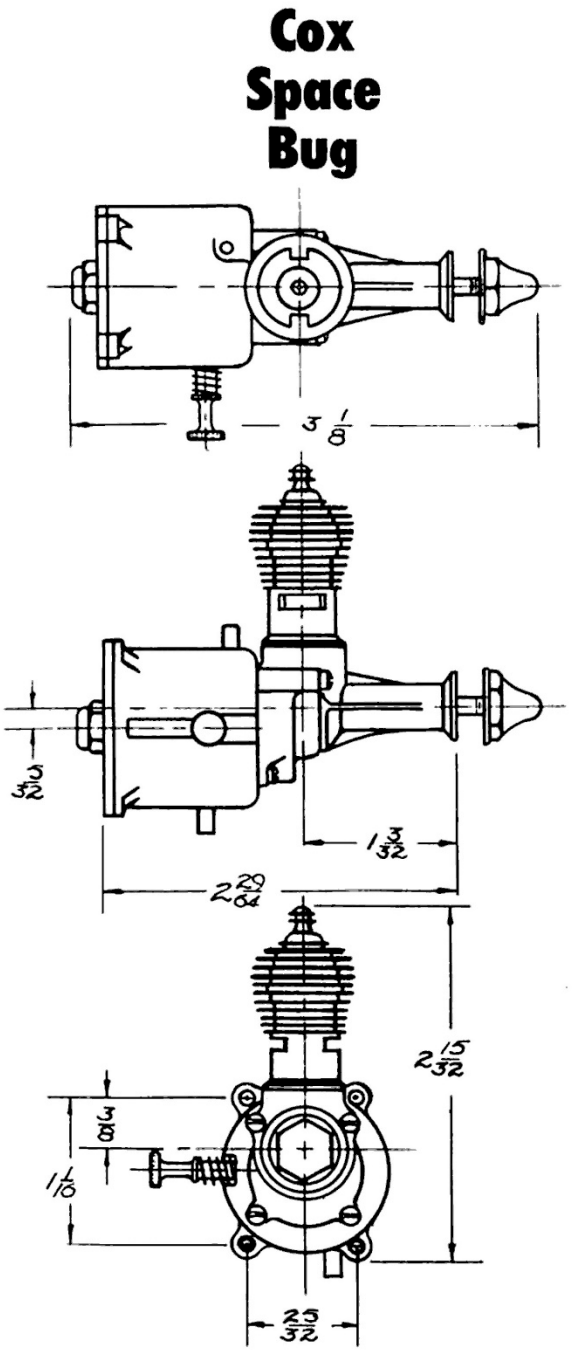
Cox Space Bug .049

Engine Review



by TED MARTIN

► The Thimbledrome Space Bug .049 incorporates major technical advances in Half A. The efficiency of these fundamental changes are proved by the resulting performance. Craftsmanship and general provision for long life and sustained peak output are of the very highest order.

To achieve the performance figures attested to by our own bench tests of the Space Brig sec table at end of article, Cox was well aware when designing this engine of possible, first unfavorable impressions of the tank size and position, the position of the intake for choking, combined head and plug, the need of lank replacement in event of jet damage, the long overhang, but felt that the means justified the end. These features are part of the design picture of the engine and so help attain the high rpm figures in the tables.

The reasons for these unorthodox features will become evident when the working of the Space Bug is thoroughly understood.

For the first time appearing on a production engine is the glow clement built directly into the cylinder head. This results in a near perfect hemispherical combustion chamber with no crevices and obstructions to impede gas flow to the filament and obstruct the radially expanding flame front. It also definitely controls compression ratio by precluding the use of different plugs with clement recesses of indeterminate volume. This has a very great effect upon small engines and it is important in all Half A motors to stick to plugs specified by the manufacturer. The Space Bug head has a very small element recess, thereby minimizing unscavenged dead space round the filament which dilutes the fresh charge of mixture with trapped burnt gases in the place where you least want it. Finally, this head, being made entirely from aluminum, presents a combustion chamber surface of uniform temperature and texture. This head design is an important factor in achieving the outstanding performance of this engine, and on test, under four hours of hammering at high speed, and using two volts for starting, along with other deliberate abuse, the element refused to burn out.

Even in the apparently rare event of a new head being required, the cost of only sixty five cents

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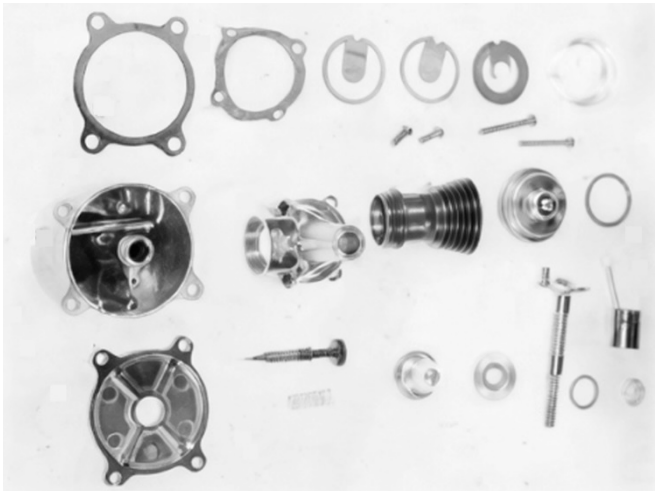
compares favorably with that of a conventional plug, in view of the extra efficiency.

The cylinder is executed from heat treated alloy steel, the bore having a surface finish and accuracy that are exceptional, and the general cylinder design has a welcome rigidity that will preserve this accuracy under the most arduous conditions. The integral cooling fin and porting arrangement is renowned for efficiency with freedom from bore distortion, a common weakness, and is a system which has been amply proven by highly stressed European diesels.

This porting system of two opposed exhausts and two opposed bypass ports, between one another and on the same plane, was dropped by most manufacturers some three years ago as being volumetrically and aerodynamically in-ferior to the 360° radial design. It is therefore intriguing to see a new engine setting a. new- high in performance from the old system. The only obvious explanation seems to be that most radial systems are inclined to atomise the fuel quite thoroughly as the mixture blows out of the bypass ports; whereas the old system is not so good in this respect, it is quite likely that it is even better at the real business of admitting and releasing gases and, since our spray-bar carburetors are poor atomisers, we have never before seen it work to advantage.

With the leaf type admission valve employed in the Space Bug, however, the fuel practically vaporized as it passes the sharp edges of the leaf, and the mixture arrives as a highly com-bustible gas at the hot bypass ports, thus giving the porting system a very great advantage. This is borne out by the fact that the Space Bug is a clean running engine producing virtually no smoke. Efficient combustion is achieved.

The piston design is ingenious and original. Machined from bar, hardened, ground and honed, the walls gradually increase in thickness towards the point of maximum stress at the crown which has the usual conical form. The ball joint features a method of retention which allows no play and slop. This is achieved by seating the ball in a spherically recessed boss inside the piston, and retaining it with a formed aluminum cup which is slotted to allow sideways entry of the rod shank. This cup has sufficient spring to allow a snap ring to be located in the groove in the piston skirt, without leaving the slight play necessary to



Below Parts of the Space Bug reveal more unique features, such as combination plug head, needle in tank, and the reed valve intake.

assembly of most other types of ball joint. The rod has absolute freedom of oscillation and is excellently lubricated by oil entering through the slot in the cup and thence flowing down and around the inside. Another important ad* vantage of this arrangement is the relatively large area of well lubricated bearing surface provided, which will give exceptionally long life.

An unusual feature of the Space Bug pistons and cylinders is that they are all produced to the same dimensions. This means production limits of one forty thousands of an inch, which is engineering at its very finest, and until recently, considered by many authorities to be economically impossible, owing to the high scrap potential. Usually, selective assembly methods are employed which means that every piston and cylinder forms a matched set. replacement of one requiring replacement of both for maximum power. In the Space Bug you can replace cither component individually and yet maintain the same efficiency.

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The conrod is machined from aluminum, the ball end having almost perfect sphericity, and the crankpin bearing displaying outstanding finish with no reaming marks, with the unusual luxury of machined and chambered faces on both sides. The fit on the crankpin is just right, in view of the high surface finish of both components. The general design and dimensions of this rod are such that it will comfortably survive the most severe abuse.

Tire crankshaft design shows recognition and treatment of two problems which have been, hitherto, largely ignored in small engines as being too insignificant for serious consideration. However, with engines that turn 17.000 rprn. and upwards, some attempt at balancing is bound to show a slight benefit, and the damaging effects of vibration on featherweight models, particularly with tank mounted engines, justify some corrective measure. With comparatively low speed small engines it is unlikely that a counter-weighted shaft would make any difference, but with the high performance of the Space Bug, together with the overhung tank mounting, this type of crankshaft pays off to a surprising degree. The Counterweight on the Space Bug is arranged to balance all the rotating weight in the engine, but ignores the reciprocating weight of the piston assembly, which is impossible to completely balance in a single cylinder engine and, while not the theoretical ideal, has been found to give the best results in practice on model racing engines. One explanation of this phenomenon is that the resulting high gyroscopic stability resists and damps out the high frequency oscillations set up by the rapidly reversing piston. As a result, the Space Bug is exceptionally smooth and free from vibrations.

The other question has been frequently raised in previous tests, namely, the vital effect of the crankshaft bearing upon engine performance and the importance of reducing surface friction to the absolute minimum. The Space Bug has polished shaft and crankcase bearings, but in the absence of the usual shaft rotary valve, is able to incorporate additional improvement. If you will visualize the loads on a crank shaft, the piston is trying to push the shaft through the bottom of the crankcase. It is prevented by the shaft bearing which is, of necessity not in direct line with the pressure from the piston, and therefore gives rise to a couple which tends to tilt the shaft. Since there has to be a small amount of bearing clearance for free running, the shaft actually does tilt a minute amount, so that it is only resting on

two points in its bearing; on the bottom at the back end and on the top at the front, lite inevitable result is that a shaft bearing always wears egg shaped and tapered. It therefore becomes evident that the center portion of the shaft does no work as a bearing, and since it also causes viscosity drag on the surrounding oil, would be better out of the way, and thus allow oil to flow more freely to the heavily loaded portion at the front. The Space Bug achieves this aim by reducing the shaft

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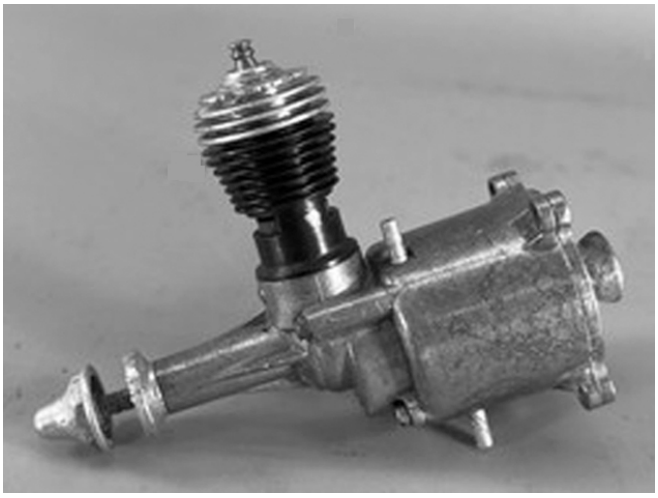
diameter in tire center and leaving 5/16” length of bearing surface at each end. It will be found in practice that this small surface will give less friction and longer running life than a normal full bearing shaft. The Space Bug is one of the smallest production engines featuring a phosphor bronze crankshaft bushing.

The crankcase is pressure die-cast in aluminum alloy with the bushing cast in position. The volume of the crankcase is very small for this displacement and therefore achieves a very high charging efficiency. A large circular dumber is cast on the back of the crankcase on a slightly lower center line. This dumber accommodates the reed valve assembly which is mounted on the front of the fuel tank. Four bolts passing through lugs in the crankcase, screw into the face of the fuel tank to secure the two units, with a paper gasket scaling the joint. These bolts arc equally spaced so chat the tank may be located in any of four positions. Since the tank has one up, one down, stunt vents, and the carburetor is east into the tank with the needle valve projecting from the side, this arrangement offers four different engine mounting positions, i.e. upright, inverted, and either side, with the vents and needle control in the same position model-wise. By turning the tank upside down, you have the same choice of mounting, but with the vents set up for U control in the opposite direction. An important advantage is that the needle control is situated well away from the prop.

The most distinctive feature of the Space Bug is its reed admission valve and a great deal of patient experiment must have gone into its development. The concept of the reed or flap valve is considerably older than gasoline engines, and is by no means new to the two cycle engine, as it has been applied in principle on many full size designs, notably on outboard motors. However, it has often suffered from an inability to work efficiently at very high speeds owing to inertia effect and the small magnitude of the force which operates it, namely, atmospheric pressure. The properties required of the reed arc extreme lightness, springiness and resilience. It must flex easily and to a great degree, without losing its shape, and in order to achieve lightness and therefore low inertia, must be made from a metal that has these properties when rolled to less than tissue paper thickness. Steel has but little spring under this condition and would be difficult to temper accurately, but the tough and much more expensive beryllium copper has apparently been found satisfactory. This material has high fatigue resistance and provides a reliable and very efficient valve. It is particularly important, however, not to leave raw fuel containing nitro in the engine when not in use, as it attacks this metal more rapidly than steel. Chemical action will



reduce the working life of any unemployed nitro burning engine, unless it is run dry and flushed with Castor oil prior to storage.

The operation of the reed valve is simple. When the engine sucks, the valve opens, and when the engine blows, the valve closes; which to be more specific, means that when the piston commences its upward stroke the area of low pressue in the crankcase is filled by mixture, motivated by atmospheric pressure pushing the teed valve open, and when the piston returns on the down stroke, the high pressure thus created in the crankcase pushes the valve dosed. In the Space Bug the reed is in two layers of the same material, one being extremely thin and able to conform exactly to the intake port seating, and the other somewhat thicker to provide springiness and

protect the first. The degree of flutter is limited by a pressed steel backing plate in order to prevent valve damage from flexing beyond the elastic limit of the material, and to ensure that it does not open so far that it cannot close in time to conform with the operating cycle. These components are retained in position on the valve seating, which is also the front of the fuel tank, with a pressed on aluminum flanged ring. This ring is easily pried off for valve replacement, but should not be removed unnecessarily as the interfer-ence fit will gradually be spoiled.

The advantages of this type of admission valve are several. The most important is that, whereas conventional types have predetermined and fixed opening and dosing events which remain the same regardless of engine speed, they are therefore only efficient at one particular speed. The reed valve, on the other hand, opens and closes according to the demands of the engine, and, if correctly designed as in the Space Bug, is efficient at all operating speeds, so that the engine will have good torque and turn big props at low speeds, or wind up to 20.000 rpm on small props and give high power output at high speeds. It also means that although the Space Bug is a very fast engine, it will nevertheless, start and handle easily.

Correctly dimensioned for the particular engine, the reed valve will provide a larger valve opening and therefore enable higher volumetric efficiency, and consequently higher engine power output.

The large fuel tank incorporates in the same casting the entire carburetor unit and fuel system, with the induction pipe or air intake passing through the center of the tank and retaining the tank back-plate in position with the aid of a screw-on air filter. This little filter is designed to prevent dirt from interfering with the reed valve seating, and will also retard the tendency for excess fuel to find its way from the intake into the fuselage of a model.

The prop nut is specially made to eliminate the need for a washer, and the tank casting includes the pick-up tube, thus eliminating the neoprene tube. The cylinder head is designed to use the conventional glow-plug connector clip, and the needle valve is long enough to allow convenient operation when the engine is fully cowled. All machining, particularly of threads, is top quality both for finish and accuracy.

PERFORMANCE

When bench testing the Space Bug, it should be borne in mind that the pickup tube is located in the tank at center line level on one side to ensure efficient feed in flight, and consequently, under static running conditions, only half of the fuel capacity will be consumed. The remainder should therefore be drained after running, to avoid trouble from old congealed oil deposits. If the tank proves inconveniently large for power duration flying, the capacity can easily be reduced with filling pieces.

A feature of the reed valve is that the engine is enabled to run in either direction with equal efficiency, and the Space Bug has a tendency to start in the opposite direction to that intended, particularly on small props, no matter how hard you flip the prop. This is aggravated by partial flooding, and a certain amount of experience is required with the motor to know just how much to choke for a dean start in the right direction. Apart from this slight inconvenience, the Space Bug is a dream to start. Needle control is excellent, and once the correct setting is found for top speed, further manipulation is unnecessary for re-starting. A point to bear in mind is that the needle design is such that its precise operation depends mainly on the fit of its thread, and that unnecessary twiddling will cause rapid thread wear with erratic adjustment.

The racing combination now available for the Space Bug further improves the performance and, as the test figures show, is well worth the extra cost.

TEST

Thimbledrome Space Bug .049: Plug Integral

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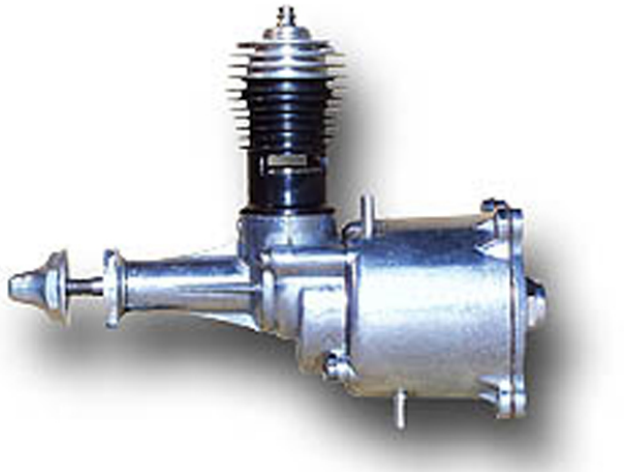
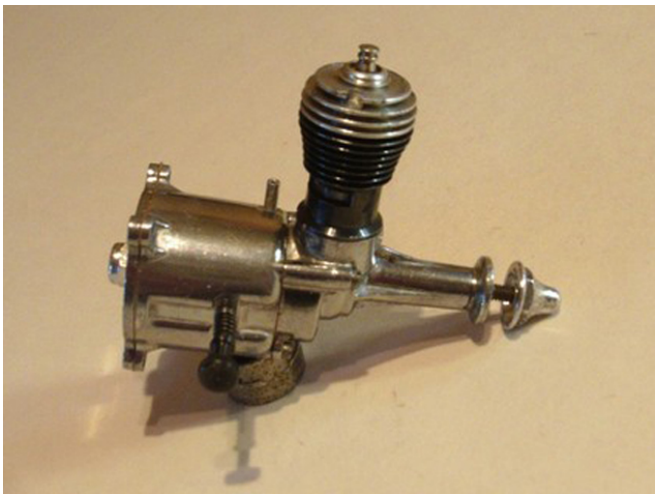
with head, 1-1/2 volts to start, Fuel O & RAA, Running time prior to test 2 hours, Bore .406''; Stroke .586" ; Weight 1.64 ounces.

Power Prop	R.P.M. (Std.)	R.P.M. (Racing Carb)	R.P.M. (R. Carb & Head)
6x5	11.500	11.500	12.000
6x4	15.000	15.050	15.500
6x5	15.200	15.400	16.000
5-1/4 x 5	15.900	14.000	14.550
5-1/4 x 4	15.850	16,600	17.200
5-1/4 x 5	18.500	19.500	20.000

Top Flite	R.P.M. (Std.)	R.P.M. (Racing Carb)	R.P.M. (R. Carb & Head)
6x5	11.000	11.000	11.550
6x4	12.400	12.400	12.900
6x3	14.000	14.150	14.700

Space Bug Plasticote (at supplied)
15.000 15.200 15.850





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