

A rotating-cylinder-valve 4-stroke

RCV 120-SP

by Gerry Yarrish

Whenever I show the new beehive-shaped RCV 120-SP engine to my modeling buddies, the first thing they always ask is, "Oh! Is it a Wankel?" I tell them, "No, it's a rotating-cylinder-valve engine." "A what?" is usually their second question. Designed by Keith Lawes, this unconventional engine is a big departure from the standard model airplane engine-design layout philosophy. Manufactured by RCV Engines Ltd., the 120-SP is the second in its RCV line; the first was a .60-size engine. The 120-SP operates much like a 4-stroke engine but with two big differences: first, the piston travel is in line with the prop shaft/piston sleeve component, and second, the prop revolves at half the crankshaft speed. Let's take a closer look.

THE BIG DIFFERENCE

The most unusual thing about this engine is that the piston's cylinder sleeve is supported by two ball bearings that permit it to revolve and drive the propeller. At the front of the engine, the prop shaft is an integral part of the sleeve. At the cylinder sleeve's base is a large bevel gear that engages a smaller bevel gear driven by the



crankshaft. The piston and connecting rod that drive the crankshaft are inside the sleeve and travel fore and aft in line with the prop shaft.

Another interesting feature of the RCV engines is they are started with a hex-shaped starter wand that engages the crankshaft well behind and at a 90-degree angle to the propeller. Since the crankshaft gear is half the diameter of the cylinder gear, the engine's prop rpm are gear-reduced at a ratio of 2:1, which greatly increases the engine's torque output. (More on this later.)

The cylinder is made of steel, and a port opening is machined where the $\frac{5}{16}$ -inch prop shaft and the cylinder body meet; this port leads to the combustion chamber. This arrangement forms a rotary valve directly behind the front shaft bearing. The single opening acts as both the intake and the exhaust port as it revolves under the carburetor and exhaust portions of the engine case. The intake, ignition and exhaust portions of the engine operating cycle are not quite 120 degrees apart from one another as can be seen by the front view shown in Figure 1.



A highly unconventional "4-stroke" engine, the RCV 120-SP produces lots of torque and turns very large props.

PISTON AND CRANK

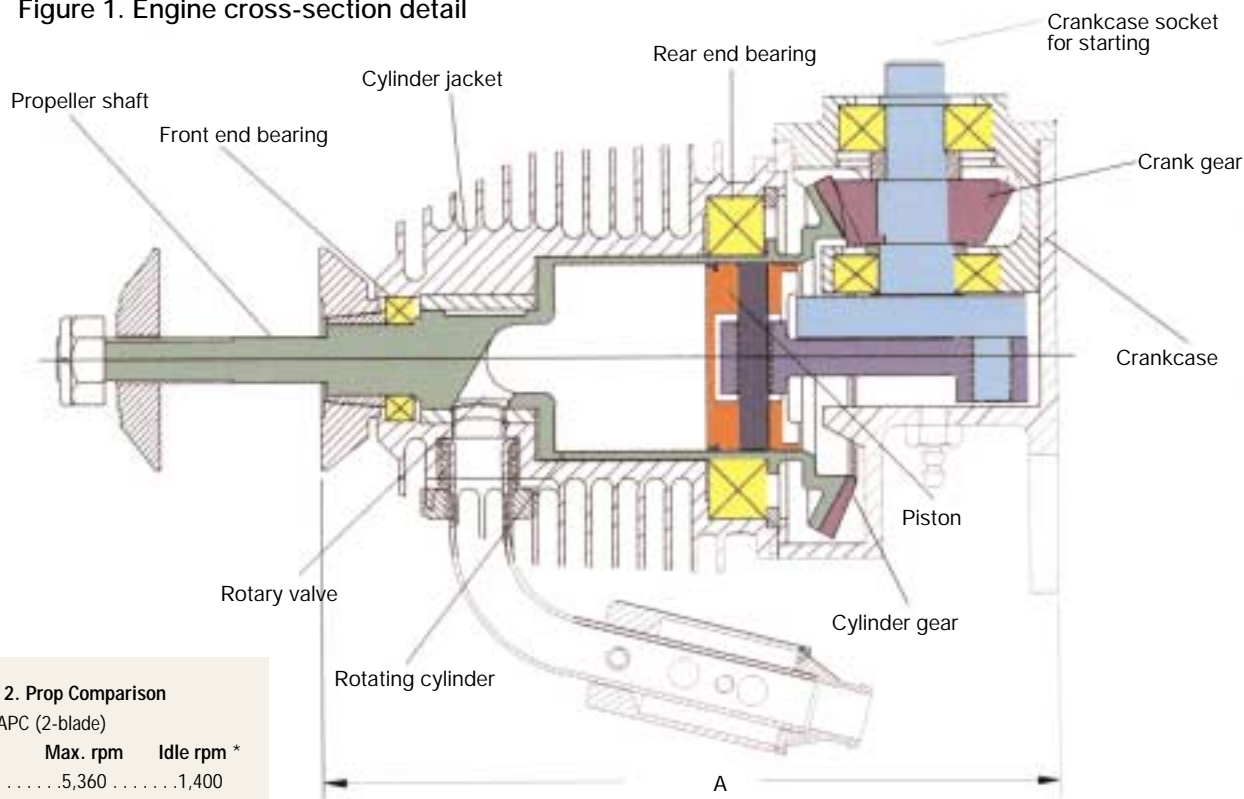
The piston is machined of aluminum and has a conventional cast iron piston ring for proper sealing. The wristpin is press-fit within the piston body. Since the piston traverses within a revolving cylinder wall, it isn't surprising that the ring isn't pinned into a stationary position. Also, according to the manufacturer, the cylin-

SPECIFICATIONS

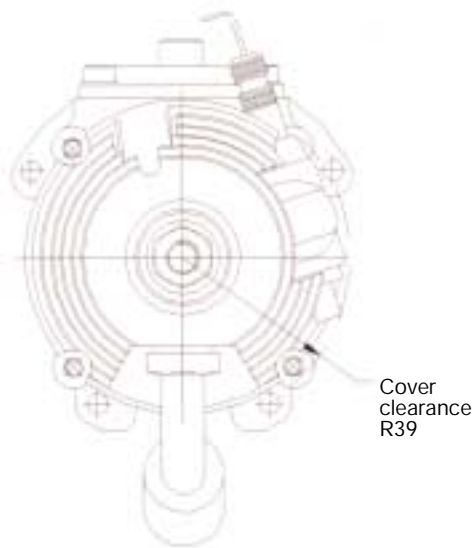
Engine: RCV 120-SP
Manufacturer: RCV Engines Ltd.
Displacement: 1.20ci (20cc)
Weight: 36.4 oz. (without muffler)
Length: 4.92 in. (125mm)
Engine diameter: 3.10 in. (78mm)
Prop shaft diameter: $\frac{5}{16}$ in.
RPM range: 1,200 – 6,000
Max. horsepower: 1.8hp @ 5,800rpm (prop speed); 11,600rpm (crank speed)
Price: \$399

Comments: the RCV 120-SP is a unique and interesting powerplant that produces a lot of torque compared with other engines of similar displacement. It operates on a 4-stroke engine cycle and has a 2:1 gear-reduced prop rpm. It operates with large-diameter props that have roughly twice the pitch normally used. The engine has a crankcase-starting socket that accepts a hex-starting wand. The wand is an optional extra (\$22.25), and one size fits all RCV engines.

Figure 1. Engine cross-section detail



Front view



Mounting dimensions

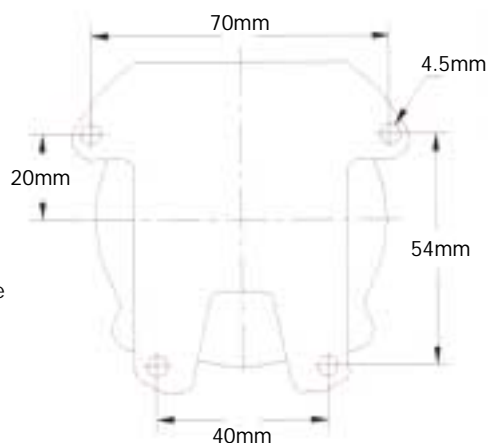


Figure 2. Prop Comparison

Type: APC (2-blade)

Size	Max. rpm	Idle rpm *
18x16	5,360	1,400
18x14	5,400	1,400
18x12	5,460	1,450
17.5x18	4,930	1,500
17x18	5,000	1,400
17x13	5,550	1,500
17x12.5	5,560	1,500
17x12	5,700	1,450
16x16	5,500	1,500
16.5x14	5,650	1,500
16.5x13	5,700	1,500
16x12	5,750	1,550

Type: APC (4-blade)

15.5x12	5,300	1,600
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Type: Menz (2-blade wood)

18x10	4,900	1,390
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*with glow driver

Air temperature: 51 degrees F
 Barometric pressure: 30.04 in.
 Humidity: 29 percent

der wall is not tapered toward the combustion chamber as it would be in a typical ABC engine. The connecting rod is machined of solid aluminum and is bushed at both ends. The lubrication hole drilled into the con rod's lower end faces toward the piston instead of away from it as is found in conventional setups. I suspect that this is because very little lubrication

passes over the back of the crankshaft pin, as most of the fuel charge enters and exits from above the piston. During engine operation, however, I noted more than adequate lubrication of all internals.

The crankshaft is housed in a separate engine-case assembly that also forms the engine-mount portion of the case. The crank is counterbalanced and is supported

by two needle bearings that are seated in the aluminum housing bolted to the main engine case and sealed with an O-ring. The crank end that's opposite the crank pin terminates with a large replaceable capscrew. This capscrew engages the hex-shaped starting wand used to start the engine.

The engine case (cylinder housing) is

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made of a solid piece of aluminum and is deeply finned to dissipate engine heat. The cylinder housing and the crank housing are held together with four cap-head bolts. This arrangement has an unanticipated benefit: the engine case halves can be assembled in any of four positions without changing the engine's timing or operation. This means you can adjust the engine's layout and the position of the starting socket relative to the exhaust pipe. The engine comes with the socket placed 180 degrees from the exhaust. Depending on your engine installation, you can have the exhaust pipe facing down and the starting socket on the left, top, right or bottom of the engine. This is a nice touch that any scale modeler can appreciate.

Opposite the starting socket is the crankcase breather fitting. This fitting shouldn't be connected to the fuel tank; it



This assembly houses the crankshaft and crank gear as well as the support bearing and starting socket. The unit seats into the crankcase.

should be left to outside air pressure as is done with most conventional 4-stroke engines. As an experiment, I connected the muffler's pressure tap to the crankcase breather with a short length of fuel tubing. I found no advantage in doing this, as there was no increase or decrease in engine performance.

INTAKE, IGNITION AND EXHAUST

The carburetor is a standard 2-needle arrangement with a 1/2-inch-diameter carb barrel and a 0.332-inch intake diameter.



Here's the engine's internal layout. The biggest difference between this engine and a more conventional one is that the piston is housed within the same part that turns the prop.

The carb is attached to a 90-degree intake manifold that bolts onto the engine case with two cap-head screws. The venturi faces aft, and the high-end needle faces up.



The ringed piston looks quite ordinary. Note that the oil hole drilled into the conrod's lower end faces toward the piston.

Throttle linkage attached to the throttle arm fits easily in a straight-line arrangement that makes the pushrod placement uncomplicated.

The exhaust port is a bit more than 90 degrees from the carb and it faces downward. The exhaust pipe and muffler are identical to those found in standard 4-stroke engine units, and the pipe screws into the engine case. A jam nut securely holds the pipe in position. You can rotate the pipe and

exhaust to face anywhere in a 360-degree radius. (Of course, you can't operate the engine with the muffler pointed forward, as it would interfere with the propeller.)

The engine came with an O.S. F glow plug which is the plug recommended in the instructions. You should not use a plug with an idler bar, as this would protrude too deeply into the combustion chamber and could possibly jam the engine. Because the glow plug is so closely positioned to the propeller, you should not use a clip-on glow-driver battery to start the engine. For

additional safety, I installed a Sullivan Head-Lock glow-driver extension on the plug and positioned the energizer receptacle well aft of the prop. This step is highly recommended in the instructions as well.

ENGINE OPERATION

The instructions recommend that 10-percent-nitro fuel containing at least 15 percent oil be used to operate the 120-SP engine. In all my tests, I used Powermaster fuel with a 15 percent nitro and an 18 percent oil content. I attached the engine to my break-in stand—a plywood firewall and box structure screwed onto an old picnic table. To adjust the throttle, I used a 12-



Above: here you can clearly see the rotating-sleeve/propshaft component. Note the single port cut into the large forward portion.



It acts as both the intake and exhaust ports. Left: at the aft end of the sleeve is a large helical gear. It mates with the small gear that's driven by the crankshaft at the back of the engine case.

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Above: shown here is the cylinder jacket or main engine case. Note the large main bearing that supports the sleeve and allows it to revolve. Below: the crankcase is CNC-machined from a large block of aluminum. It also serves as the engine's mount.



inch-long Du-Bro pushrod and plastic clevis that passes through the hole in the firewall, and I pressed a short length of fuel tubing into the hole to act as a throttle-position friction lock. The recommended break-in prop is an APC 18x12. (More on props later.) Do not attempt to start the engine by turning the propeller; the gear reduction of the prop output shaft makes that very difficult. By using the engine's starter socket and wand, engine starts are quick and effortless.

The low-end needle valve is factory set, and I did not have to adjust it. To start the engine, I opened the high-end needle three full turns and opened the throttle to about the 1/4 position. To start the engine, your starting wand has to turn opposite (clockwise) to the prop rotation. I turned on the glow driver and engaged the electric starting motor and wand. The engine started instantly and settled into a medium rpm range. Then I opened both the throttle and the high-end needle until the engine ran at full throttle with a very rich mixture at about 4,000rpm. I ran the engine this way for several 15-minute intervals before I

began to lean the mixture. After about five tanks of fuel, throttle response was solid, and the engine ran very smoothly and reliably.

The RCV engine has a unique sound that's somewhere between a 2-stroke and 4-stroke engine's cadence. When the mixture is set properly, the engine sounds slightly rich and has a "poppy" sound. Starts are easy, and throttle transition is smooth from idle to full open. If the mixture is too lean, the engine is difficult to start at low throttle settings. Though it runs cleanly from high to medium throttle settings, the engine tends to die at low settings. An overly rich setting makes the engine run rough and begin to sputter at idle—especially when the glow igniter is switched off.

Until the engine was fully broken in, there was about a 200 to 250rpm drop when I turned off the glow igniter. After break-in, the rpm drop is only about 100. Finding the maximum rpm setting is exactly the same as with any other model engine: lean the mixture until the rpm peaks and then back it off a few clicks to the rich side. Turning an 18x12 APC prop resulted in a maximum rpm reading of between 5,200 and 5,500 revs; the idle was a very nice 1,400 to 1,500rpm.

RUNNING BIG-PITCH PROPS

At first, the rpm reading of the RCV 120-SP seems low. This is true until you remember that the engine output is geared 2:1. With so much torque, the 120-SP easily turns much larger props than a conventional 4-stroke engine can, and it doesn't overheat. To compensate for the lower prop pitch, you have to turn props that have roughly twice the normal pitch. Recommended prop sizes for the 120-SP are 2-blade 16x16, 17x13, 18x12, 18x14, 18x16 and 20x12 props and the 15.5x12 4-blade prop. Landing Products, as well as RCV Engines Limited, has several of the APC high-pitch Pattern Aircraft props, so getting them is as easy as a phone call. See the prop table (Figure 2) for the rpm readings I found while running the engine. For general sport flying, the 18x12 2-blade prop is recommended, and the 15.5x12 4-blade prop is recommended for the faster sport flying designs. The 18x10 and the 20x12 props produce a good amount of thrust and are



Only start the engine with the behind-the-prop-starting wand. It is both easier and safer to start the engine this way.

well suited for large, slow scale models.

Having only one more moving part than a typical 2-stroke engine (the rotating cylinder), the RCV 120-SP offers many of the advantages of a large 4-stroke engine without complicated overhead valves, cams and lifter rods. The engine produces more usable torque than a conventional 2-stroke engine of the same displacement and effectively turns large-diameter props. Its streamlined shape permits easy engine installation in tight-fitting cowls, and its unique revolving-cylinder-valve



For safety, use a glow-plug extension wire and a remotely located glow-driver connector. The glow plug is extremely close to the prop, and you should not attach your Ni-Cd driver battery directly to the plug.

design sets it apart from other conventional powerplants. If you can appreciate high torque and slow-turning big props, and if you like "thinking out of the box," then you'll find a lot to appreciate in this engine.

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Landing Products, 122 Harter Ave., Woodland, CA 95776; (916) 661-0399.

PowerMaster, P.O. Box 650, Elgin, TX 78621; (512) 285-9595; fax (512) 285-9400.

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