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The Care, Feeding and Behavior of the Warner Super Scarab "165"

This started as an information memo to an antiquer on the care of his newly majored engine. The thought struck me that since Warners in general and the 165 in particular are some of the most commonly used powerplants on our members ships, and expanded version in the "Antique Airplane News" might be useful.

The following is based on 20 years of working on and flying behind Warners of all types except the 110. I am limiting this, however to the 165 Warner for brevity and because I have the most experience with this model.

The 165 Warner, in my opinion, is the best small (under 400 HP) radial ever built. After a thorough and knowledgeable major, it is a highly reliable and with proper care and use it should go a MINIMUM of 500 hours until a top overhaul is required and a MINIMUM of 900 hours before another major. Many run 800 1300 hours respectively.

Most care for a 165 is the same as for any other engine and these common practices I will not note. Instead I will confine this strictly to the particular areas germane to the 165.

A newly majored engine will run hot to start with. It will gradually run cooler until final stabilization at about 50 hours. IF YOU DONOT HAVE A CYLINDER HEAD TEMPERATURE, INSTALL ONE. There is no way you can operate the engine properly otherwise. Excessive cylinder head temperatures will shorten engine life and can cause failures. Oil temperatures indication lags too much to be useful.

Use straight mineral oil onley (SAE 100 inter winter and SAE 120 in summer). Compounded oils, despite anti foaming agents, foam too much within this engine and the resulting cavitation will shorten bushing life. Change oil at 50 hours or six months whichever comes first. Drain oil with the engine hot. If your plane is not to be flown for an extended period, pull the prop through 10 or 12 blades once a week. Ground running during storage does more harm than good. It is impossible to get the oil hot enough on the ground to remove the acids and water without overheating this engine and, therefore, leads only to the formation of more acids and water.

The scavenger pump on the 165 is somewhat marginal at idle R.P.M. Long periods of idling will tend to lead the case and flood the lower cylinders. Run the engine at 1100 to 1200 RFMs for one minute prior to shutting down to scavenge the case.

Oil consumption on a newly overhauled engine should stabilize between 25 and 50 hours at not more than 4 hours per quart. After this period, which is required for seating the rings, much of the oil consumption is through the intake valve guides due to the external overhead oiling system. This system keeps the rocker boxes partially filled during operation. Every time the intake valve opens a little oil is pulled through the guide. The looser the guide, the higher the consumption. Intake guide seals can considerably reduce the consumption (10 to 15 hours per quart are possible). Perfect Circle P/N 2012 (Kit VS4) seals fit the guide without modification; however, the teflon insert must be reamed from its original .375 I. D. to .400 I. D. to provide a .003 interface fit on the valve stem.

The oil pressure relief valve should be set at 65 psi with the engine hot. The pressure pump on this engine is excellent and will often maintain the set pressure at idle on a runout engine. Oil pressure (good or bad) is not necessarily an indication of engine condition.

The oil pressure relief valve is very sensitive to foreign matter. A particle of carbon or a bit of gasket fibre can hang it open causing the oil pressure to drop somewhat and to start following the throttle, going to zero at idle and climbing to 45/50 psi at cruise RPM. This will not harm the engine and you can continue to the next airport for repairs. BE SURE THE SYMPTOMS ARE AS NOTED ABOVE. A distorted spring of a burred sleeve sometimes causes the oil pressure to fluctuate when the engine is hot. Increasing the pressure setting 5 psi or so will usually stop this while you are obtaining replacement parts.

While I'm talking about problems, failures of any kind are very rare on the 165. I know of only two types which have occurred often enough to even mention. On very rare (I have heard of only three) occasions, a link rod pin bushing will loosen in the master rod. This bushing cannot come out immediately but will work out until each rotation of the crank throw shaves a small particle of bronze off. This will show up in the oil at the next change, (I strain my oil through a double cheesecloth as the oil screen will not catch anything much smaller than a piston ring). Metal in the oil is of course, cause for immediate grounding until the source is determined. If it is bronze, the master rod is the first place to look.

The second type isn't nearly as serious. A valve spring retaining washer sometimes fails. This usually happens when the valve springs have been installed upside down but has been known to occur with proper installation. The central boss of the washer will remain intact and prevent the valve from dropping into the cylinder. However, the valve will hang open and if it is an exhaust valve you will find yourself running on six cylinders with considerable vibration and a sound like a blown spark plug. Failure of the washer on an intake valve is much more dramatic. When the defective cylinder fires, it backfires through the open intake into the induction housing causing the next few cylinders not to fire. The engine goes whirrp-bang-silence-whirrp-bang-etc. I can assure you the engine will function under this condition longer than your nervous system. You can make the next airport if you haven't chewed your way through the seat first. (Knowing what is happening helps a lot.)

To get back to care and feeding: I find 1850 to 1900 RPM good for cruise don't be afraid to lean at any altitude, attitude of power setting PROVIDED cylinder head temperatures are kept within limits. The 165 is rated on 73 octane fuel and there is no way you can make it detonate when using 80/87 or higher octane fuel. If you are using an E.G.T., run it as near maximum temperature as possible with the engine running smoothly. At maximum the engine will probably run rough due to uneven fuel distribution. Without an EGT, lean to 25 RPM drop beyond maximum RPM or at the maximum lean the engine till it runs smoothly whichever comes first. KEEP THE HEAD TEMPERATURES WITHIN THE LIMITS. The higher octane fuel we are forced to use today shortens exhaust valve life since it burns slower and tends to still be burning when the exhaust valve opens. To reduce this problem I set my ignition at 31 degrees BTC instead of the recommended 28 degrees. Also I set my exhaust rocker arm clearance (cold) at .012 instead of the recommended .010. This combination increases the effective rotation of the engine about 10 degrees prior to opening of the exhaust valve without affecting the intake cycle. (The intake clearance should be .010.)

Valves, however are not the limiting factor on the time between overhaul. Rings are the normal limiting factor for the top end and the master rod bushing is usually it for the bottom. Bad rings are noted by high oil consumption. Over a quart an hour and it is probably time. A worn master rod bushing is noted by a marked increase in oil temperature under normal operating conditions. The excessive clearance causes the oil to circulate too fast for proper cooling. Excessive clearance between the crankshaft and the extension shaft or in the coupling pin can give the same symptoms. Whatever the cause, high oil temperature combined with high engine time indicated you will probably need to rob the kid's piggy bank soon.

On a newly overhauled engine the valve clearances, mag timing and mag point gap should be reset at 50 hours when everything has settled in. They probably won't change much in the future but should be rechecked every 100 hours. Set mag points .012. DO NOT readjust points to "fine Tune" mag timing.

If AD 54-4-2 (installation of 3/8" cylinder hold down studs and replacement of cylinder base gaskets with "O" rings) has not been complied with, check torque of the 5/16" nuts(160 to 200 inch/lbs.) every 100 hours. Check low (160 inch/lbs.) side only . DO NOT OVER TORQUE. With 3/8" hold down nuts torque should be 200 to 275 inch pounds.

Check the thrust nut every 100 hours. There is no safety on this nut and should it loosen it will allow the inner race of the thrust bearing to turn on the crankshaft damaging same and deflating your billfold in the process. To check, remove the prop, place a SOFT drift in one of the two slots in the face of the nut and give it a sharp rap with a hammer. If it dosen't move, it is OK. Warner specifies 6000 to 6600 inch pounds of torque for this nut. I have made a wrench with 2 1/2 foot bars on each side. With a foot on one bar, both hands on the other and a lot of grunting I think I'm pretty close but I always give it a couple of whacks with a drift and hammer anyway.

Be suspicious of any Warner with chromed cylinders. Unless the heads have been removed (a very chancy proposition and not recommended) or the head/barrel interface thoroughly masked, the plating solution will attack the copper head gasket which can cause leakage and even the possibility of loosening the head. Look in the holes adjacent to the head hold down nuts in the upper barrel flange. If you can see the gasket and it is not badly pitted it is proably O K.

On the 165s with Holley carburetors make sure the needle valve seat is safetied. I know of one forced landing caused by the unsafetied seat backing out. The pilot passed the word around in his area and a couple of other unsafetied seats were found.

I have now told you everything I know (and a few things I don't) about the 165. Undoubtable, I have overlooked something of importance so comments will be appreciated. I would like to see a series of articles on Kinners, Menascos, Rangers, Lycomings, Wrights, Lamberts, etc. by people with experience. Someone stick their neck out with me.

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