GOOD SENSE ENGINE OPERATIONS

BY TONY BINGELIS

We learn a little about operating our aircraft engine properly during our initial exposure to flight training. A little more is learned through experience as we build up flying hours. And, right or wrong, we "learn" even more from others during "bull sessions" and hangar discussions where spirited exchanges of opinions, experiences, and "superior" knowledge on the subject of aviating abound.

The best and most reliable advice, as always, regarding how to operate your engine sensibly is naturally obtained from the manufacturer's engine manual for the particular engine you have installed in your aircraft. It will provide you with the ultimate guidance you need.

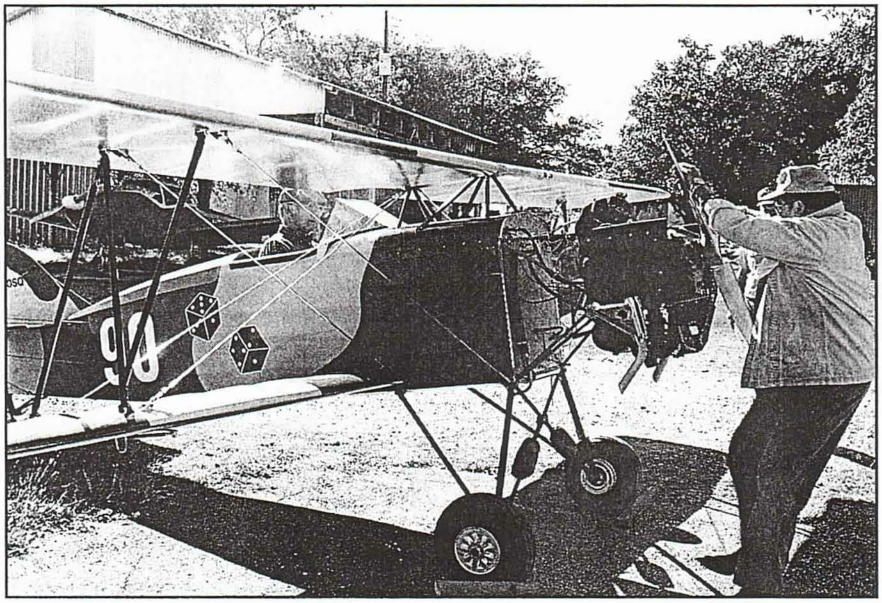
Unfortunately, such manuals seldom answer all the questions you may encounter in the day-to-day operations of your engine. I find it most interesting and encouraging to learn that the small air cooled aircraft engines most of us fly are very reliable and perform quite predictably when operated properly.

These 4-cylinder aircraft engines were first introduced many years ago and have changed very little up to the present. Among the more plentiful of these engines are the 4-cylinder Continentals (A65s, C85s, C90s, and O-200s) and the Lycomings (O-235s, O-290s, O-320s and O-360s).

They have been operated by literally thousands of owners, operators and mechanics for millions of hours under a myriad of conditions.

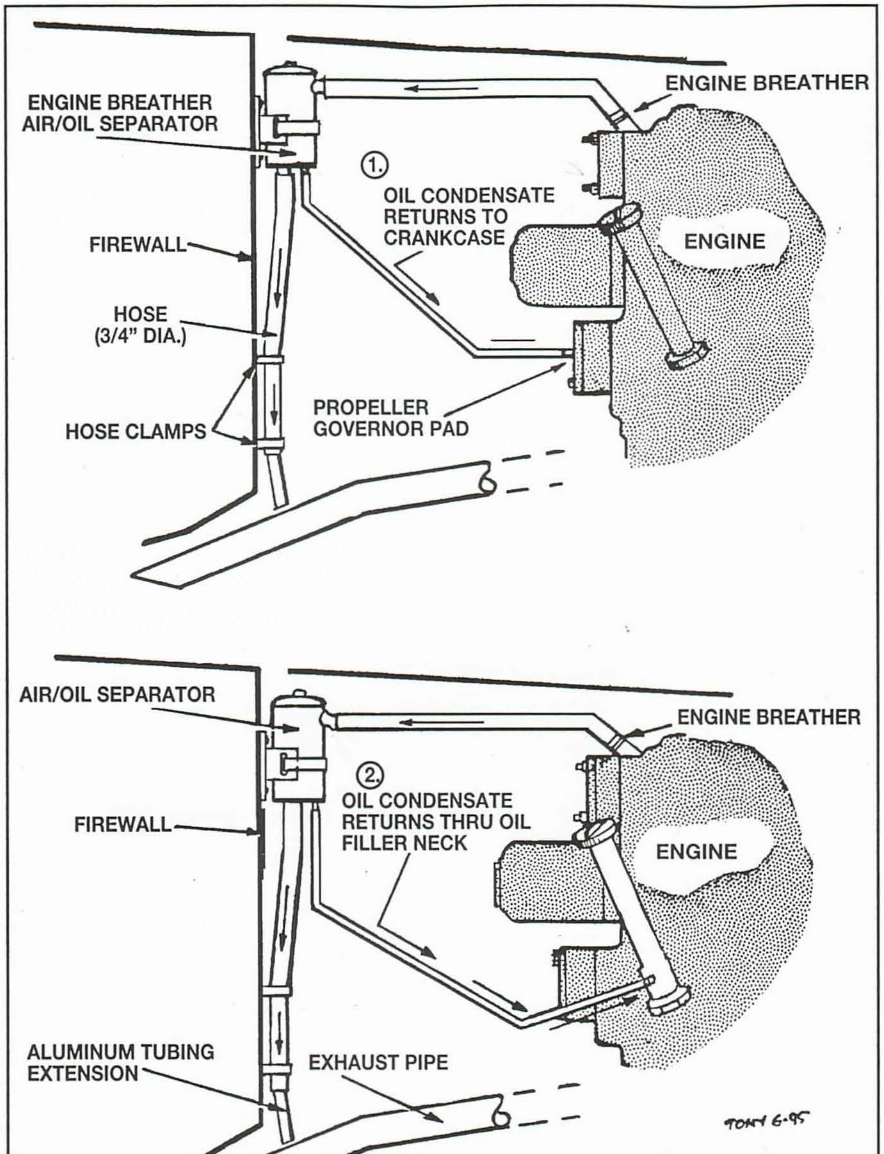
Many operational lessons have been learned and many opinions have long since been formed regarding how these engines can be operated safely and efficiently. Do the engine manufacturers, experts and "old timers" agree? Let's see what you think.

NOTE: To keep this discussion brief, I will try to confine my subjec-



Turning the prop through four or five blades before attempting to start the engine each day will give you a number of important cues as to the condition of your engine. How many can you think of? Refer to the text under "Engine Starts."

Don't blast your throttle to get the airplane rolling. Prop vortices will suck up dirt and pebbles even on paved surfaces. use minimum power to get the airplane moving...then smoothly increase power to keep it rolling.



OIL BREATHER/SEPARATOR INST'L
(CRANKCASE RECOVERY OPTIONS)
FIGURE 1.

tive comments and observations to the 4-cylinder air cooled carbureted engines driven by fixed pitch propellers. These are the most frequently used by homebuilders.

DON'T BABY THAT ENGINE

That's what most of them say. Surprised?

Do you really believe you are treating your engine kindly by not using full throttle for takeoff … and habitually operate it at very low cruise rpm? If you do, you are mistaken. You will be saving a bit on fuel costs but may be setting the stage for future operational problems…and possibly increased maintenance bills.

Low power settings tend to deprive the engine of adequate cooling air and invite spark plug fouling as well as the build-up of cylinder varnish … none of which is good for a long engine life.

Your aircraft engine, unlike an auto engine, is designed to operate under high power output conditions. This means you can operate your engine at 75% of its rated power indefinitely. At pressure altitudes above 7,000 ft. this may require full throttle to achieve and maintain. By comparison, auto engines are designed for operations within a much lower 25 to 30% range of their rated power.

Before an aircraft engine is issued its Type Certificate by the FAA, it has to be capable of operating at full throttle for many hours during a test stand endurance run. This must be successfully accomplished with its oil temperature and cylinder head temperatures maintained within their normal operating range. In view of all this, running your engine for a mere five minutes at full power during takeoff and climb will hardly faze your engine.

AS FOR OIL CHANGE FREQUENCY...

The general consensus is that oil should be changed regularly. Ordinarily this is after every 25 hours of flight for an engine not equipped with an oil filter—and 50 hours for an engine sporting an oil filter.

Like all generalities there are exceptions, aren't there? What if your airplane is flown only an hour or so once a month? Would you let the engine go for two years before changing oil? I hope not.

As bad as infrequent flight is on an engine, infrequent oil change is just as harmful…if not more so.

To remove accumulated moisture, contaminates and sludge from the oil, consider changing your oil every four months even if the recommended oil change hours aren't reached in that time.

OIL CAPACITY VS OIL LEVEL

Your engine's oil capacity may be greater than it needs to be for safe operation.

For example, most 4-cylinder Lycoming engines have an oil capacity of 8 quarts. But, did you know that the manufacturer also states that the oil level can be as low as 2 quarts and the engine would be safe to operate?

Certainly, I wouldn't advocate taking off on a long flight with such a low oil level in the engine. However, most homebuilders soon learn that the ideal oil level in their Lycoming is about 6 quarts.

If you try to maintain a full 8 quart level, the engine will quickly spew out at least one quart in short order. This equates to a higher oil consumption than necessary, doesn't it?

THE ENGINE BREATHER FUNCTION

If the belly of your aircraft is dirty with an oil slick, you can generally blame that on the copious air-oil vapors expelled through the engine crankcase breather.

It could be that an oil separator can help keep the belly of your airplane clean and, also, minimize the loss of oil while allowing the engine to breath freely.

The usual practice is to install an oil separator on the firewall and run a small oil drain line from the separator back to the engine. Some builders accomplish this by attaching the drain line to a fitting screwed into a tapped (3/8" NPT) hole in the base of the oil filler neck, or into a cover plate where a prop governor would have been installed for a constant speed prop.

A few builders don't like to reintroduce the excess breather oil residue back into the engine because the oil may still contain moisture and contaminants that have passed through a less than efficient oil separator.

Rather than returning the expelled oil to the crankcase, why not collect that small amount of oil condensate into a container which you can empty periodically ... say at every oil change (see Figure 1).

And what an ugly looking mess it is ...no wonder many builders don't want that stuff draining back into their engine.

ENGINE STARTS AND GROUND OPERATION

Quite a few pilots make a habit of turning their propeller through about 5 blades or more before starting the engine. Of course, they are careful to check that the ignition switch if OFF.

Even so, care must be taken any time you propeller is moved...even with the switch OFF because a "P" lead may have become disconnected and the hot magneto will fire when least expected under the right (wrong?) circumstances.

Anyhow, turning the prop through before starting the engine can be useful as it will:

1. Help lubricate the cylinder walls, especially if the engine has been idle for a week or so.
2. Prove that you have compression on all cylinders.
3. Give you the opportunity to inspect the condition of the propeller closely.
4. Tip you off if you have a leaky valve.
5. Verify that your impulse coupler is working.

For better cooling always try to face the aircraft into the wind especially when awaiting your turn for takeoff.

Avoid high power run-ups on the ground because the engine will not cool as well as it would in flight.

High power run-ups, if they are necessary, must be kept brief.

After any high power operation, allow your engine to idle for a minute or two before shutting it down to help dissipate excess heat.

Avoid running your engine uncowled because it is not good for the engine...the cylinders will cool unevenly and hot spots may develop.

If it is necessary to check the idle mixture, try to do it quickly, running the engine only briefly.

TAXIING

Don't blast the throttle to get your airplane rolling. Prop vortices will suck up dirt and pebbles even on paved surfaces. The consequence could be badly chipped propeller blades.

A safer procedure would be to use a minimum of power to get the airplane rolling...then smoothly increase the power to keep it moving. This technique helps reduce the ability of the propeller blades to suck up damaging particles.

Taxiing at too high an rpm is poor practice because you will be controlling your speed by riding the brakes. This is, usually, unnecessary. Even with a free swiveling nose gear, only an occasional tap of a brake pedal will be needed to keep it rolling straight.

Of course, taxiing in a crosswind may require a slightly high rpm ... but be aware of the need for what you are doing.

TAKEOFF AND CLIMB

Avoid following another aircraft too closely down a dusty/dirt runway because even the best air filter won't protect your engine from ingesting a lot of crud.

Many pilots pull the power back immediately after takeoff. I consider this to be rather risky because it seems more engine failures occur during the first power reduction than at any other time.

For that matter, I see nothing wrong in NOT retarding the takeoff power until a safe altitude has been gained and that first turn in traffic is made.

Remember, we are talking about the small engined, fixed pitch jobs—not the big powerful types that are capable of shattering windows unless power and props are pulled back for climb. Actually, you should be able to climb to a reasonable cruise altitude without reducing power.

Many homebuilts, and some ultralights, will climb about 1000 fpm.

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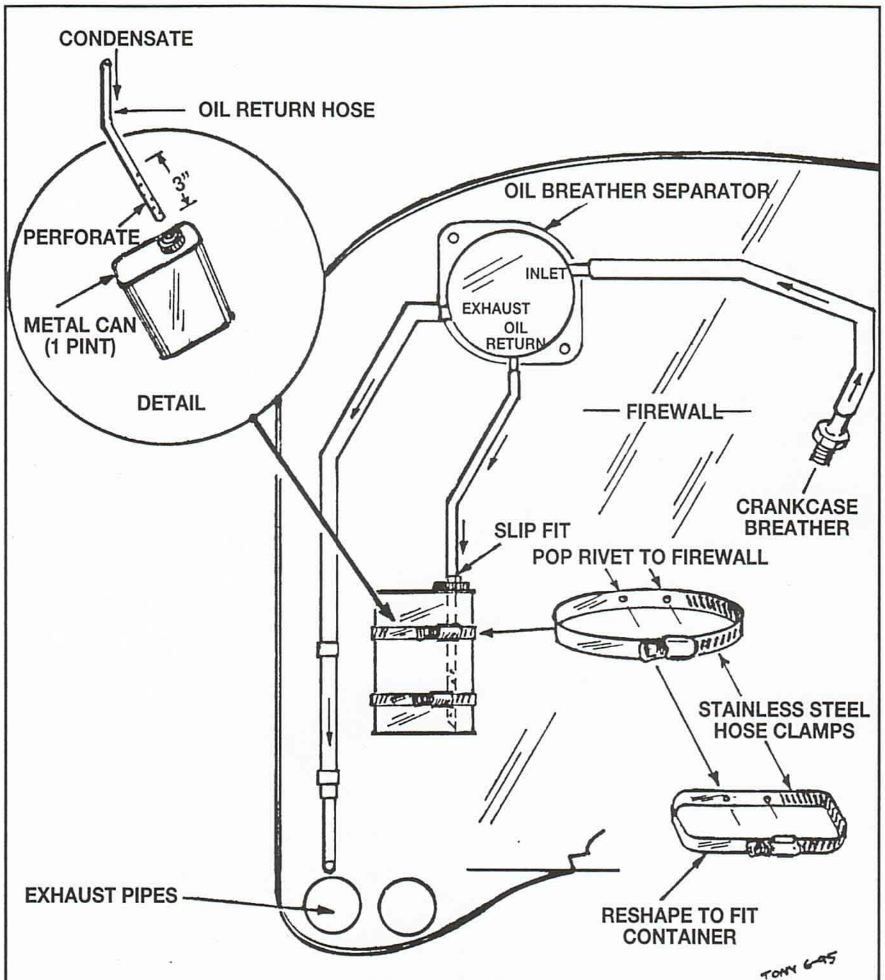


**OIL BREATHER SEPARATOR
(OIL CONDENSATE COLLECTOR)**
(SCHEMATIC)
FIGURE 2.

Therefore, in five minutes of full throttle operation you can usually climb to 5000 feet...if you want to go that high.

My Lycoming O-320A Fuel and Power Chart indicates that with full throttle, my engine, at 8000 ft., will be producing only 76.2% of its sea level horsepower...this with 23.4" Hg and 2400 rpm, or 24.5" Hg and 2300 rpm. Therefore, I can lean aggressively even though I may be tooling along at full throttle.

For safety's sake your electric fuel pump (booster pump), if you have one, should be turned ON for takeoffs and landings.

ON LEANING

I believe in leaning my Lycoming almost from the ground, certainly as soon as the throttle is partially retarded. Lycoming recommends "aggressive" leaning for all power settings of 75% and below.

The higher the field elevation the more useful the initial leaning effort becomes...actually it might be essential for smoothing the engine for takeoff. Naturally, you would not, ordinarily, lean the engine anytime it is putting out full rated power (2700 rpm) as detonation becomes a potential risk.

Anyway, when you come right down to it, most homebuilts flying with a fixed pitch cruise propeller will seldom develop full power for takeoff, therefore, a judicious leaning of the engine during the climb should never be a problem.

LET DOWNS

An engine can cool excessively during a let down, especially in cold weather. This could be bad as it invites lead fouling and can lead to cylinder cracking and excessive wear.

Start your let down early. By reducing your manifold pressure two or three inches from your cruise setting, or the rpm by a couple hundred, you can establish a leisurely let-down without causing the engine to cool excessively. As you lose altitude, don't forget to readjust your mixture in order to maintain smooth engine operation during the descent.

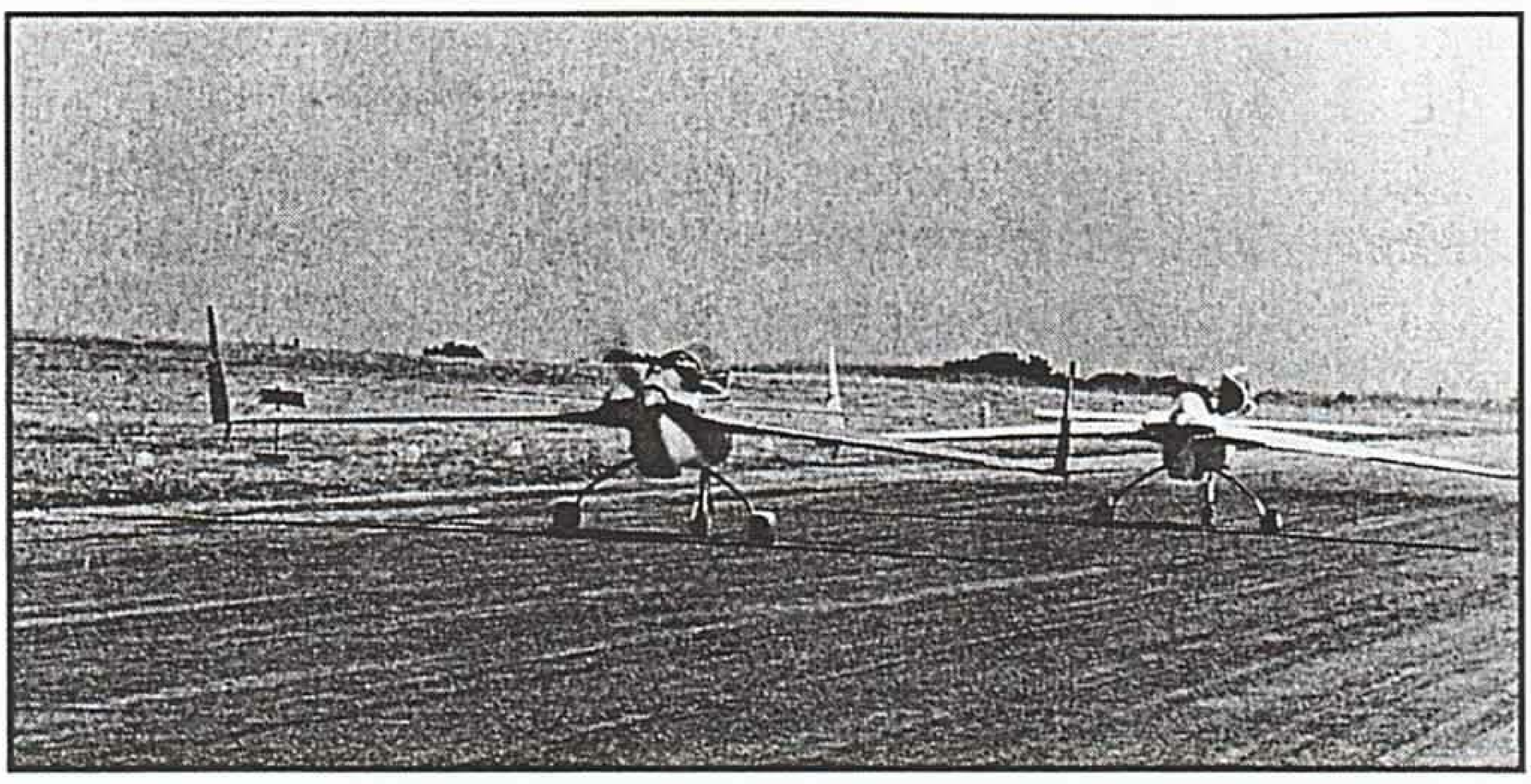
Chopping the throttle and allowing the airspeed to build up to the point where the windmilling propeller is driving the engine is bad, bad, bad. Keep your engine warm especially during cold weather operations.

USE OF CARBURETOR HEAT

The general belief is that engines equipped with pressure carburetors or fuel injectors are more or less immune from carburetor icing problems and need no carburetor heat provision.

There is no doubt however that carbureted engines are vulnerable to

Formation flying can be especially hard on the engine and throttle control linkage due to the frequent throttle movements from full power to idle ... especially at the hands of a pilot new to formation flying.



Don't follow another aircraft too closely down a dusty/dirt runway because even the best air filter won't protect your engine from ultimately ingesting a lot of crud.

carburetor icing and that they must have some provision for carburetor heat.

Induction system icing problems can crop up even in the summer when humidity is high and the temperatures are ranging up to 90°F simply because the mixture chamber temperature can drop as much as 70°F from that of the inlet air.

I learned that my Continental engines were more prone to carburetor icing than are the Lycoming engines I currently fly. I suppose this is partly because the Lycoming's intake manifolds are routed through the sheltered warmth of the engine crankcase. Continental engines, on the other hand, have no similar set up.

Always apply the carburetor heat before reducing the power, otherwise, the engine won't produce enough heat to prevent carburetor icing. It really doesn't do much good trying to apply carburetor heat when the engine is idling ... there won't be much, if any.

No need to use carburetor heat for takeoff and climbs because icing at full throttle is most unlikely. As for cruise and other flight conditions, you would ordinarily leave the carburetor heat in the cold position.

If you experience a loss of power on a damp hazy summer day, suspect the formation of carburetor ice. Use full carburetor heat, or none at all, unless you have a mixture temperature gauge to help you adjust your carburetor throat mixture to above the 32°F freezing level.

ON SWITCHING FUEL TANKS

I don't know about you, but I don't look lightly on the simple matter of switching fuel tanks in flight. No, I have never

Start your let downs early. Reduce manifold pressure two or three inches from your cruise setting and rpm by a couple hundred rpm to establish a leisurely let down without subjecting the engine to excessive ("shock") cooling.

had a bad experience in this regard, nor have I ever switched to an OFF position, or an empty tank inadvertently. Yet, the reluctance remains. I also avoid walking under ladders.

If I have the option, I try to time switching tanks when passing by a suitable forced landing area or an airstrip of some sort.

Following the same line of reasoning, I always avoid switching tanks in the traffic pattern just before landing and just before takeoff ... risky practices at best.

As you switch tanks, it is a good idea to look at the selector valve to confirm the tank selected and that the selector is not incorrectly positioned between tanks...it does happen.

On switching tanks, be sure to monitor the fuel pressure gauge for a few moments, assuming, of course, your aircraft is equipped with one. It will quickly show whether or not the tank switching is successful.

FORMATION FLYING

This type of flying can be especially hard on the engine and throttle control linkage, particularly at the hands of one inexperienced in the art of formation flying.

Rapid throttle movements, from full power to idle, either on the ground or in the air, cause various parts of the engine to expand and contract at different rates with engine temperature changes. Abnormal wear takes place in the control linkage and elsewhere each time this is done because of the erratic torsional stresses and temperature stresses induced.

Incidentally, throttle chopping is a major factor in cylinder head cracking and other engine problems. The practice is equally damaging in flight regimes other than formation flying.

IN SUMMARY

These few random thoughts only touch lightly on the subject of sensible engine operations. There are many additional considerations that come into play, especially with so-called "high-performance" aircraft where the engine drives a constant speed propeller, is equipped with a fuel injector instead of a carburetor and may even be turbocharged.

As I pointed out in the beginning, when in doubt consult the engine manufacturer's engine manual for guidance.

In addition, any homebuilder who wants to operate his engine in an efficient and professional manner should obtain and study the book by Kas Thomas, entitled, Aircraft Engine Operating Guide (Belvoir Publications, Inc., 1111 E. Putnam Ave., Riverside, CT 06878). I recommend it highly. ◆

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