

**WARBIRD NOTES # 5** 31 Oct 94 (16)  
**FEATHER BUTTONS & PROPELLERS**

This subject keeps coming up when misconceptions are repeatedly encountered during discussions of these systems on oral exams and/or flight

checks. You probably won't get much help from looking at the pilot's manuals of that time period, these systems weren't explained in much detail, either in the "runup" or the "emergency" sections. Probably this was considered to be a basic part of every aviator's experience or knowledge acquired in ground school. Maybe discussing what we're looking for during the runup of a piston engine airplane or dealing with while we're attempting to cope with an emergency would be of some benefit.

I guess we could start with some of the things we should be looking for during a runup of a typical piston engine aircraft. Some flight manuals call for initially advancing the throttles to 1500 RPM, others vary and may call for up to 1700 RPM for the propeller check. It seems to me that 1500 RPM should be sufficient to provide an adequate governor function check and, at the same time, minimize any engine heating. The important thing here is don't spend an excessive amount of time (the CHTs are heating up all this time) getting precisely the right RPM's, close is good enough for this check.

Once the RPM's are set, pull the prop controls full back to decrease and let the RPM's decrease a few hundred as engine oil is forced into the dome, thereby moving the blades towards a higher pitch. You don't have to wait to reach the absolute lowest possible RPM's these first few times, just get a couple of hundred drop and make sure the prop functions correctly as the oil is forced into the dome. Return the prop controls to full increase and let the RPM's recover as the blades again move towards low pitch. Repeat this action as necessary to get a good prop response as progressively warmer oil from the engine is introduced into the prop dome. Obviously with cold oil it'll take longer to achieve a rapid and correct cycle but don't make a career out of exercising the props.

Then, during the last cycle you intend to perform (after you're satisfied with the response), leave the prop controls in the full decrease RPM position and allow the prop governors to reach their full minimum governing (high pitch) position. This RPM should be spelled out in your flight manual, usually it's about 1100 - 1200. Checking this is important for the following reason. If you need to feather an engine during flight you'll obviously need the feathering pump to do so. If the feather pump should fail (which happens just often enough to make it more than conjecture) you'll have some **serious** problems staying aloft. You'll have to establish a minimum drag configuration with the throttle closed and the prop blades in the highest pitch you can obtain. If you've got a prop that is way high on this check you're going to find the drag increased a bunch! Kind of like the old Bamboo Bomber (UC-78) which didn't have feathering props. Following this check return the prop controls to full increase. (As a side note, the low pitch blade internal mechanical stops are checked, in a round-a-bout way, during the later engine field barometric power check.)

Next, let's discuss the prop feathering check. After completing the previous check spin the red feather button a few turns clockwise to make sure it's screwed tightly onto the feather button shaft. More than one has come loose in the pilot's hand when pulled up to terminate the feather check (more on how to deal with this later). Push the button down and note an increase in loading on the generators as the electrical feathering pump starts to run. Depending on oil temperature and viscosity it may take a little while

for the feathering pump pressure to start driving the RPM downwards. (During cold weather if this indication doesn't occur within several seconds you would be wise to prevent possible feather pump burn-out by discontinuing the check and re-exercising the props a few more times, introducing warmer oil into the domes.) It is only necessary to observe a small amount of drop (100-200 RPM) to confirm the beginning of the feathering process, the holding coil should then be overridden by pulling the feather button back up. At the same time remember to note a corresponding drop in electrical load as the feathering pump is shut off. It's not unknown for the feather pump to keep running so look for this to avoid big troubles. Now, what should you do if the button should pick this extremely inopportune time to come off in your hand. First of all, don't try to screw it back on, you just aren't going to get it done that quickly. Probably you'll find yourself temporarily stymied if it should happen to you but you should keep your wits about you and remember that the holding solenoid is electrically actuated. Immediately knock off all the batteries, then all the generators. That's all there is to it! When you remove the electrical power from the holding coil (magnet) the button shaft will pop up and - voila -, the prop goes back to normal governing. Actually, there is one more thought here. Even if you only turned the batteries off, if you then pulled the throttles back on the other engine(s) to below generator cut-out speed the generator on the feathering engine would cut-out when the RPM fell below that speed. The holding coil would then release. I'd strongly recommend that you dry run this procedure for practice every so often, touching each switch so that it would be second nature without any fumbling around - should you ever have to do it for real.

After you finish the feather check I'd advocate that you do one more check. We didn't do this in the military but learned it on the airline. This check ensures that RPM control has been reacquired by the prop governor from the transfer valve. This valve shuts off governor oil pressure during feathering (discussion later) and, if it hangs up, prevents normal governing. Pull the prop controls back and note an associated drop in RPM, telling you that the prop levers are controlling the prop. You'll only need to see a slight RPM drop to confirm this.

Now let's get to the in-flight stuff. We can pretty much divide into three scenarios what might happen in-flight when you push the feather button - one good and two bad! The good thing would be for the prop to feather and rotation to stop normally. The bad things would be; (a) the prop starts to feather but then doesn't finish or (b) it feathers but then comes back out and starts to rotate again. Almost all the time the good scenario happens and everyone's happy. But, just often enough to make things interesting one of the bad things happen and that's mostly the reason for writing this.

First, let's talk about the things that happen normally when you push the feathering button to feather a prop. The magnetic holding coil is energized by an electrical switch and the button stays down by itself. The feathering pump starts to run and its output pressure of approximately 1000 psi is directed through a transfer valve within the prop governor to the rear side of a piston within the prop dome. This pressure forces the piston (which is mechanically geared to the prop blades) towards the high pitch position and then, going further, over a cam into the feathered position. As the blades reach the fully feathered position the pressure (if you could measure it) would probably be a little less than 300 psi. The pump continues to run, building up more pressure. As it reaches about 400 psi this pressure deactivates the switch which releases the electrical circuit to the holding coil. When this coil releases, the button will "pop" up to its normal position. The prop blades will be nicely feathered, rotation stops and everything's great.

Well - -, at least as great as it gets with a loss of an engine! What I've just described was the normal scenario.

Now let's discuss the second half of the good scenario, unfeathering. Push down on the feather button and the first thing you'll notice is that you must hold it down. Why? Well, remember that the piston inside the dome was shoved all the way over the cam in order to feather the blades and it took somewhere around 300 psi to do that. As you push down on the button the feathering pump starts running and immediately builds up to 400 psi, releasing the electrical circuit to the holding coil as described in the preceding paragraph. As you hold the button down the pump continues to build up pressure towards 600 psi (passing the nominal 300-400 psi it required to feather). That amount of pressure then unseats the distribution valve (within the prop dome) and repositions it, redirecting this pressure to the forward side of the piston within the prop dome. This pressure begins to move the blades in the opposite direction (out of the feather position) and the prop starts to rotate. Pressure from the feathering pump continues to drive (assisted by centrifugal twisting moment) the blades back into the normal range and you'll need to release the button at 800 RPM. Next, ascertain that the RPM stabilizes at the same RPM as you found on your run up check of the minimum governing speed. After you see this indication of governing (because you don't want to start a potential runaway), move the mixture to the AUTO-RICH position and finish your restart checklist.

O.K., the above stuff was the normal way we'd like to see it everyday. But (as Art Ward says), these machines are old and sometimes they forget. They pick inopportune times to become recalcitrant, valves stick or other things happen to confound us with glitches not mentioned in the manuals. You have to possess the mechanical knowledge that will allow you to intercede in the operation and obtain the results that will keep you in the air (at least while you want to be there). Let's cover a few more of those in the last few paragraphs.

Let's say you push down on the feather button and the prop starts to feather. You didn't keep your finger on the button and it pops up before the prop is completely feathered. Unless it's very nearly completely feathered, the RPM (assisted by centrifugal twisting moment) will start to increase and go right back to wherever you have the prop control lever set. This situation has occurred and has caused accidents when the solution is so simple! What happened? Remember that the pressure required to feather a prop is about 300 psi after which the pressure continues building up to about 400 psi, releasing the coil. If the coil switch is weak and releases prematurely the button will pop up before the feathered position is reached. Solution? Just push the button down again and this time hold it down until you see the prop stop rotating. The instant that occurs, release the button and everything's fine!

Another bad thing might happen. If you pushed the button down and the prop feathered and stopped normally but then, to your amazement, immediately started to rotate again and came out of feather - what would you do? What happened now? Well, again, it took 300 psi to feather, the pressure then built up to 400 psi and then the holding coil should have released, right? In this case the pressure switch failed to cut the electrical circuit to the holding coil (or the shaft stuck), the button remained down, and the circuit acted just as it would if you were holding the button down to unfeather. If you see this situation developing, immediately pull the button up to terminate the operation and dump the pressure. Then, push the button down again to begin the operation all over. This time, keep your fingers on the button and, at the exact instant

the prop stops rotation, pull the button up. Again, you've interceded, overridden or whatever and everything's cool!

At least one other possibility exists here! If - in the above paragraph - you pull the feather button out but it fails to have an effect, you have big trouble! Another way of determining this is if the electrical loadmeter indicates that the feathering pump motor failed to stop when the feather button was pulled. Most likely the contacts are welded by the electrical current or some other problem is causing the feathering pump to continue running. You must act immediately and quickly turn off all the batteries and generators in order to remove the electrical power to this feathering pump. This will have the same effect as pulling the button out and will allow the feathering pressure to immediately fall to zero. THEN, turn on a single battery or generator and allow that electrical power to again feather the propeller. As soon as the prop stops turning, turn off the electrical switch. You must NOT subsequently restore any source of electrical power since this would again power the feathering pump motor and unfeather the propeller! I've always said that - to the best of my knowledge - no feathering motor circuit protection is located within the cockpit and thereby being available to the pilot. I've just found out that on a few early Beech 18's there were large circuit breakers protecting this circuit on the forward glareshield beneath the windshield. It wouldn't hurt to check YOUR airplane; this information could save you or your airplane!

Now, one final thing. All the above applies to the basic 23E50 constant speed - feathering propellers used on B-25's, DC-3's, A-26's, B-17's, DC-4's, etc. It involves a two position feather button that you only push. When you get into the later props with reversing capabilities used on the Convairs, DC-6/7's, etc. the button is a three position push and pull unit. If we want to get into that we'll have to wait until a later (probably much later, these bulletins take forever to write) bulletin, it's far too complicated to include here.