

## **FLAKY FLAP MOTORS**

Over the years, we've received the occasional report of intermittent flap motor operation. We never found a consistent problem. Sometimes it was poor wiring or a bad ground, a couple times it was a switch giving up, occasionally the problem would be with the motor itself. But problems were rare, and the flap motors in our demonstrator airplanes worked day in, day out, for years.

In 2002, we switched suppliers, replacing the units we'd received from Motion Systems with a custom made unit powered by a Pittman brand motor. The new units can be identified by the Van's logo incised on the aluminum gear box housing. Not long after the change was made we got a significant number of complaints about motors failing after just a few hours.

Naturally, we suspected the new motors...but as it turns out, the newer "Van's" units were not the culprit.

Instead, the problem seems to appear in one of the last batches of Motion Systems units. These we received about three years ago and they are now starting to appear in finished airplanes. The problem is usually caused by an excess of grease in the gearbox (that's the almost cubical casting where the flap actuator tube and the motor meet at right angles). As the unit spins, hydraulic pressure pushes grease back into the motor unit and coats the windings, commutator and brushes. Grease is an insulator, and when the brushes are insulated from the commutator, yo' motor don' motate no mo'.

Cleanliness is next to...well, it makes your flap motor work better too. You can remove the cap on the end of the motor and wipe the commutator shaft clean and your motor will work for a while. But to really solve the problem, all the grease must be removed from the flap motor or the whole cycle will just repeat.

Remove the actuator unit from the aircraft and take it to a clean, well-lighted bench. Assemble a small jar of clean lacquer thinner, some cotton swabs, a Phillips screwdriver, an allen key set, tweezers and some of those very thin wire ties that come on loaves of bread. If you're of an age and have a magnifying visor, bring it.

Remove the Phillips screws from the motor assembly and gently, carefully, remove the steel cap from the end of the motor. Inside is a black plastic horseshoe wrapped around a shaft. Notice the three small holes in the heel of the horseshoe. Turn over the cap and look inside – see the little index pin? See where it goes – that hole in the horseshoe? Remember that.

There are several washers on the shaft. These must be reinstalled in the order they came out, so carefully note and preserve their orientation as you remove them.

Slide the horseshoe gently off the motor shaft. A couple of little copper colored things are going to jump out (those are the brushes). They are retained by very thin wire springs.

Now use the allen key to remove the bolts holding the motor to the gear box. Pull the motor winding/shaft assembly out of the cylindrical housing (the magnets will resist, but it will come out) and inspect it for grease and corruption.

Clean the motor and brush assembly with lacquer thinner or some other clean solvent. Scoop any excess grease out of the gearbox. There should be enough to lubricate the gears, but the whole cavity does not need to be full of grease. Be careful not to disturb the tiny o-ring in the recess of the gearbox.

Clean the commutator (the shiny part of the shaft that the brushes ride on) with the cotton swabs or even a bit of scotchbrite.

Reassembling the motor can be more difficult than getting it apart. Begin by teasing the little springs that go behind the brushes back into their recess and tie them back with the wire ties. This may take some patience... When the springs are held back, use the tweezers to re-insert the brushes, taking care that curve worn on their contact surface matches the curve of the motor shaft. Tie the brushes back.

Insert the gear end of the motor shaft back into the gearbox and check to see the baseplate is down tight. Put the cylinder/magnet back around the motor – the little notch in the rim should be on end away from the gearbox.

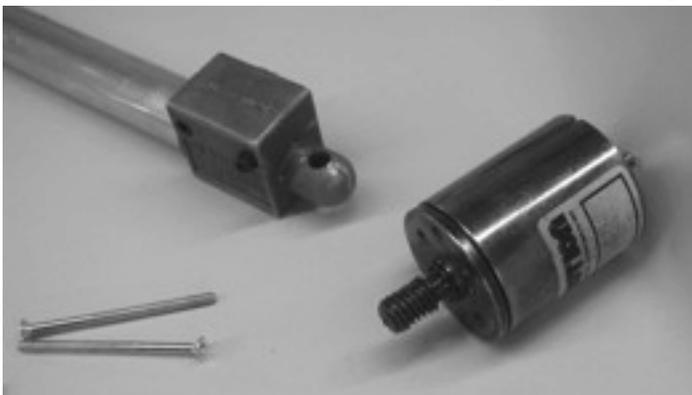
Gently, carefully put the horseshoe back around the shaft and slide the wire ties out. The springs should force the brushes up against the commutator. Reinstall the washers.

Reinstall the cap with the long Phillips screws.

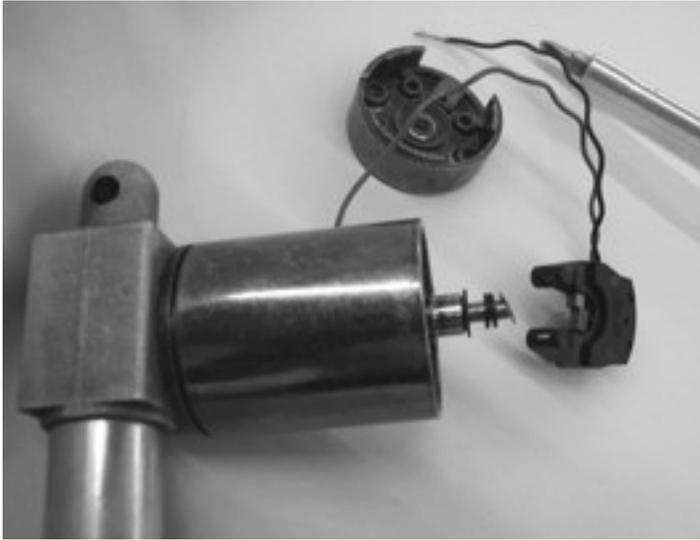
Find a 12-v battery and test the motor by holding the wires against the posts. Reversing the wires should make the motor run the other direction.



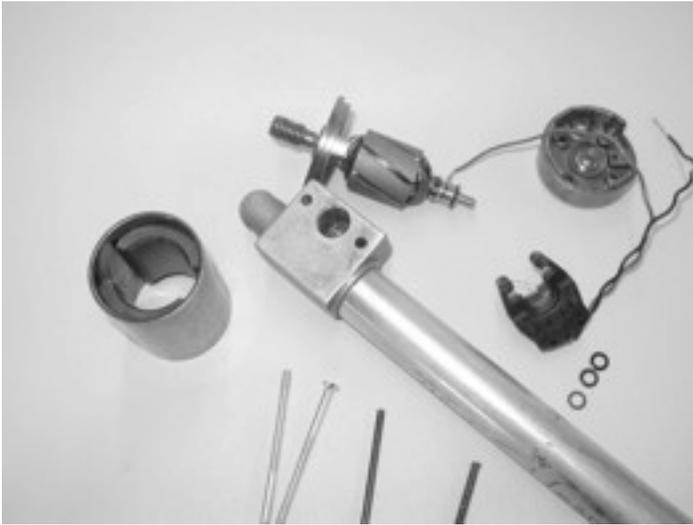
The motor unit and screws securing the housing to the gearbox.



The long phillips-head and short allen-head screws have been removed or backed off and the motor separated from the gear box.



The motor cap and the horseshoe shaped brush housing have been removed. The brushes have popped out of the housing, and if you look closely, you can see the tiny spring that must be behind the brush when it is re-inserted. The springs keep the brushes up against the motor armature.



The motor armature has been removed from within the motor housing and the washers removed from the motor shaft.

Tucking the springs and brushes back into their cubbyholes is the toughest part of the exercise. Be careful not to bend the springs. A small spacer made of any non-magnetic scrap, that keeps the brushes pushed back will help get the “horseshoe” back on the shaft.

