LOW WINGERS AND THE DEADLY RIGHT HAND TURN

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The phenomenon we will consider in this article is familiar to many flyers of low wing rubber powered scale models. It manifests itself in that initial turn down-wind. Once a low winger successfully negotiates that turn the flyer rests easy, for if a low winger is in for trouble, it usually starts right there.

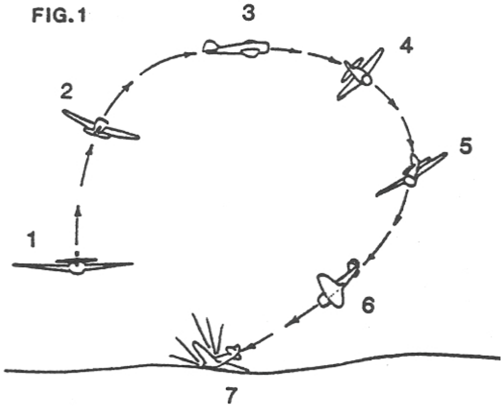
Let us review some typical flight patterns of low wing models by starting with a model that makes it's initial turn down-wind to the left. The model climbs out against the wind after launch. After gaining some altitude it begins to turn to the left. When about 100º into the turn the nose begins to drop. As the model turns further down-wind it picks up speed. zooming down a bit, then up, all the while turning left. And so it goes, into a repeat of the cycle that becomes a pattern of undulating circles usually gaining a few feet of altitude with each cycle.

How does the flyer feel about this type of flight? “Well, not bad for a low winger, but it took a long time to gain a little altitude. And those undulating circles don't strike me as being very scale-like. Maybe if I try a tad more of right thrust, or some right rudder to open the turn up,” thinks he.

Our flyer makes his trim change and tries another flight. This time the model climbs straight out into the wind. The nose gets high, the model slowing down. The nose drops to the left and the ship roars back straight at the flyer! But look what is happening to the model as this occurs ....the nose plug has pulled out of the zooming ship! How in Hung could that have happened? That plug had a 5/16 long shank that was keyed to a slot in the nose block! How could it have pulled straight out against the tension of an almost fully wound motor?!? There are very powerful forces at work here, clubsters.

Let us say our flyer put in a very little bit more trim adjustment than in the previous paragraph. The model is launched and climbs straight into the wind. It begins a wide right turn still climbing nicely. It continues the wide right turn down-wind and still climbs. Crossing behind the flyer, it comes into the wind again gaining even more altitude, and so on for a beautiful high scale-like flight of good duration.

FIG. 1



Our flyer is elated. “Boy is this crate ready! I'll be promoted in no time with the batch of kanonen this bus will win for me! Why, here comes Capt. Downthrust driving onto the field. Wait 'til he sees this ship perform”!

"G'mornin' Cap'n, sir," pipes our happy hero, saluting smartly. He describes his previous flight to the officer as he winds for a demo. He launches as before. but lo........the model flys as depicted in figure 1.

"Cripes, Cap'n, I didn't change a thing on it since the last flight. I gave it a few extra turns wuz all. Geez, it come whistlin' in-like-a bat outa hell"!

"UM." says the captain. "Ya oughta make some high wing crates. They never do any of that nasty stuff," says he as his Monocoupe screws up into the ozone like a home sick angel.

Now, the author knows that not all low wingers fly as described above. Some sit right up there turning either right or left. But we all must admit the band between being in trim, and out of trim is pretty narrow for the low wingers. You can never really count on them flying a groove the way a high winger does. Why is it so? Much has been written on dihedral and vertical fin sizing and their effect. In this study we will add another important consideration. Thrust.

Before going on we should look at the forces, and their location, that are acting on the models considered. Figure 2. illustrates both high wing and low wing configurations. The center of lift is determined by drawing a horizontal line from the mean chord on one half of the wing, to the like place on the other half. Where this line crosses the vertical center line is the center of lift.

The center of gravity is well known to all. Just remember that all three axis pass thru this point. Horizontal (roll), vertical (yaw). and lateral (pitch). Think of the CG as a ball joint around which the plane moves in any and all attitudes. Notice that the CG is below the center of lift on the high wing configuration, and above it on the low winger.

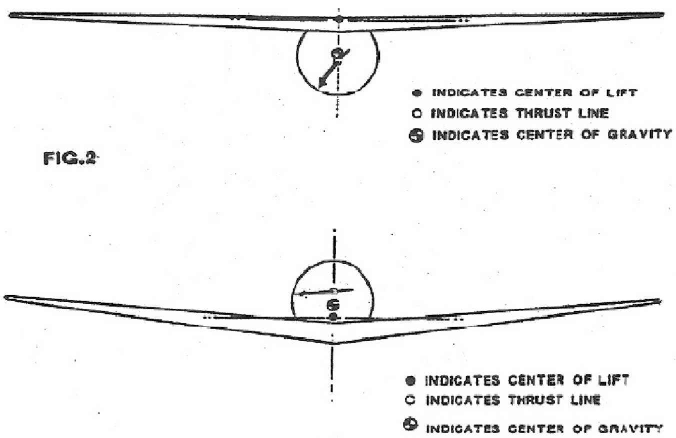
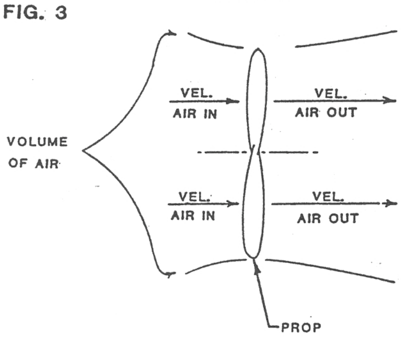


FIG.2

The thrust line position varies according to configuration. Figure 2 shows typical thrust line locations. The arrow passing thru the thrust line location shows typical offset to compensate for torque and drag differential. More down than right for a high wing. more right than down for a low wing. The high wing has more drag above the lateral axis, while the low wing has more drag below it.....hence the difference. The side thrust does not cancel torque, it only compensates for it. Side thrust induces a yaw force around the vertical axis by thrusting the nose to the right. It is aided by the slipstream blowing along the right side of the fuselage and fin. All this to try to compensate for torque, which is a rotary force around a different axis.......the horizontal axis.

FIG. 3

THRUST



THRUST = VELOCITY OF AIR OUT MINUS VELOCITY OF AIR IN TIMES THE VOLUME OF AIR MOVED

Thrust is a force often misunderstood. It is easily confused with power available. Figure 3 is a simplified explanation of thrust. An airplane sitting on the ground with it's brakes on and throttle wide open is developing maximum thrust. The same plane with throttle wide open and in level flight is developing little thrust. The reason is that in level flight there is but little difference between the velocity of the air coming into the prop, and the air going out behind it. When the reduced value of this figure is multiplied by the volume of air moved (which is about the same in both cases), you can see how thrust varies.

Now, where in the flight of a hand launched model does it develop the most thrust? It develops the most thrust in the second half of it's initial turn down wind, about at position 4 in figure 1. This is because the velocity of air entering the prop has been reduced by its turning away from the wind. It is developing more thrust to “catch up” to the speed the power available (which is still very high) can provide. Remember where the model was in its flight path when the nose plug unseated?

Now let's look at the forces, their magnitude and direction, as models go thru that crucial down-wind turn.

Figure 4 shows both a high wing and low wing model in a left turn with a 30º bank. The arrows emanating from their respective symbols represent the direction of forces of lift, weight, and thrust. On the low winger it will be seen that the lift component is tending to roll the ship into a steeper bank. But thrust, which has a slightly longer moment arm, is exerting a corrective force and now points slightly upward;, the vertical axis being no longer vertical. With the increase in thrust due to the turn down wind, the magnitude of this new found up-thrust is even greater. Also, the increase of airflow along the right side of the fuselage and fin is producing the effect of "top rudder," These two forces bring the ship into a power stall. While it continues the left turn it may side slip toward the inside of the turn until it heads back into the wind where thrust is reduced and the bank less steep, the model recovering. The cycle is repeated, and the undulating circular flight path is established.

The high wing model in a left turn with a 30º degree bank suffers no upsetting forces, as can be seen in figure 4.

Figure 5 shows us that the high wing model in a 30º banking turn to the right suffers no upsetting forces either.

But Great Hung! Just look at the forces acting on the low wing model in figure 5! The lift component tends to increase the bank, and the side thrust is now directed downward a good deal due to the tilt of the vertical axis. The flow of air along the right side of the fin and fuselage, as well as the magnitude of the side thrust that's now directed downward will be even greater with the increase in thrust during/the down-wind turn. Here then, are the powerful forces at work that we witnessed in the flight path shown in Figure 1. which is actually a terminal velocity dive!

From all this we see that our torque compensator, side thrust, in concert with a high thrust magnitude during that initial down-wind turn is the cause of the phenomenon suffered by many a low wing model.

It seems little can be done to alleviate this condition, so we must try to work around it. The best approach seems to be to just let the ship turn to the left. It is safer that way. I have rarely seen any low wings spiral into the ground from a left turn. Ah, but that open right hand turn sure has a great rate of climb built into it! A shame to pass that up.

One thing you might notice is that those low wingers that do negotiate that deadly turn do so with a very flat turn. A slow flying speed (light wing loading) can help produce a shallow bank during the turn. Perhaps a washed in left wing tip for left turning models, and a washed out left tip for models who tend to turn right.

On a model with a large fin, perhaps a judicious reduction to a size less than scale will do the trick as long as it does not offend the eye. One trick tried at Pinkham Field was clear plastic spoilers on the fin to reduce it's efficiency. They did reduce the model's sensitivity to trim changes, but in spite of being clear plastic, they were rather obvious. In truth I can find no wonder drug to cure this malady. I just keep giving it aspirins.

FIG. 4

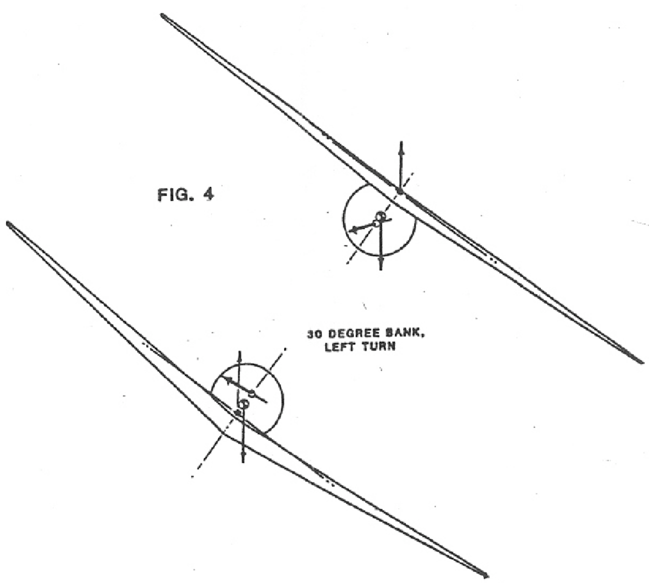


FIG. 5