TOSSUP 98

Bent-Wing / Built-Up

The BWBU contest substituted for the regular monthly contest on 8/9. It attracted 30 entrants from a variety of clubs, some quite a way from Thousand Oaks. The contest format was four rounds of 3, 6 10 and 3 minutes with landings based on a 25’ circle. The first two rounds scored landings in or out of the circle, the third round scored landings on the back half of the circle and the fourth round scored landing points for landings on the back half of the circle.

The contest lasted about four and a half hours during which time the flying conditions vaired considerably from hot and humid with absolutely no lift to breezy with strong thermal activity. Wind direction was variable which together with the single direction (East to West) of both launches and landings meant that contestants could find themselves working with headwinds, tailwinds or even quite strong cross-winds with no warning. This made flying challenging and the contest interesting.

There were a few incidents. There were three outlandings - two on the hill to the west of the field and one in a bush in the back yard of a house on Feather Ave. There were two crashes, one being a wing mount pulling off a fuselage on launch resulting in a ‘lawn dart’ and damaged fuse, the other resulting from a contestant ‘flying the wrong plane’ (which resulted in a very violent on-field crash and total destruction of the plane).

Although the flying was quite challenging at times everyone seemed to enjoy themselves so regardless of the individual and team results the contest was sucessful. TOSS came off well which is probably not surprising because many of the other contestants were new to the field and so didn’t have the ‘local knowledge’ needed to make the best use of the flying conditions. ✹

Results and Pictures Inside.........

Everything You Wanted to Know About Servos......

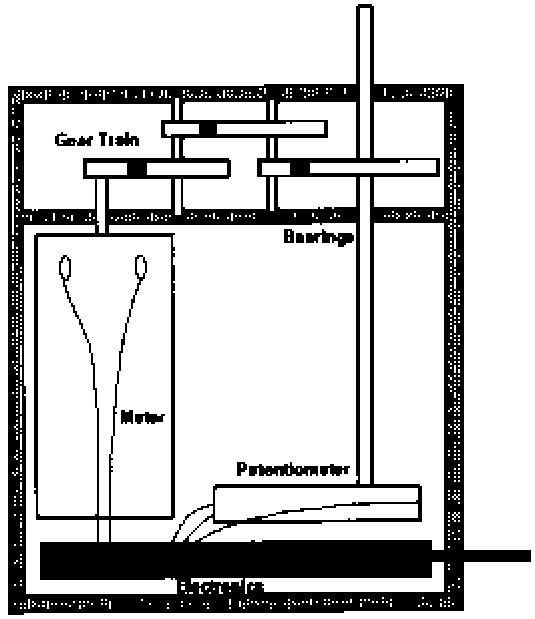
(Editor’s Note - This article was inspired by and contains material from the article by Ian Hirschsohn in the July 1998 edition of “Gull Wings”, the TPG newsletter. The TPG article is rather lengthy and contains material peripheral to the subject since its part of a series of articles on R/C electronics - if anyone would like copies “see me”. This note also draws extensively on the material in Signetics Applications Note AN133 “Applications Using the NE544 Servo Amplifier” - the NE544 or equivalent is the ‘guts’ of the servos that we use in our planes.)

We are all familiar with servos, those ‘brown boxes’ that convert the signals from the radio to movement of a control horn, but how many of us are intimate with what’s inside the things? Yes, its true that most of us have had to pop the top of a servo at least once to replace components in the tiny gear train but what else is in there?

If we look at the internals of a typical servo we see five components. Its got a motor, a gear train, a ‘potentiometer’, some electronics and a case to house the first four components. Practically every servo you can buy follows this pattern, from the smallest sub-micro to the largest for giant scale use. The potentiometer operates in exactly the same way as the component attached to the stick in the transmitter, converting the position of the output shaft into a signal that can be understood by the electronics. The electronics matches the signal telling it where the output shaft is to the signal from the receiver telling it where the output shaft should be, and if there is a mismatch it drives the motor one way or another until the shaft gets to where it should be.

The servo command signal from the receiver is in the form of a train of ‘pulses’. The servo has two battery wires to power it with the third, command, wire containing a signal that looks like someone is briefly connecting it to the positive line for about 1/1000 of a second every 1/50 of a second. The position of the output shaft is coded on the width of this pulse - if the pulse is 1/1000 of a second the servo wants to rotate to its full counterclockwise position, if its 2/1000 of a second it wants to rotate to its full clockwise position. This method of commanding the servo is used because this is how the information is carried by the radio - a 7 channel radio will send a set of 8 pulses plus a short pause. The pause plus the first pulse is used to indicate the start of the signal, the following 7 pulses are directed to each output of the receiver to drive the 7 servos.

"Since all servos are essentially the same then it follows that there will be no differences between particular servos of the same general size." This, of course, is dead wrong. The reason for this is that we, as users, want to pay $10 for a component that would cost hundreds if engineered to a proper 'aerospace' standard. The art of making the servos is therefore not in the design of the servo as such but in making it cheaply, that is, they've got to cut corners in such a way that their target user will get a product that works well for them. Since they don't have a great deal of control over the electronics (which is the cheap bit anyway) or the motor (because they're all made by Mabuchi) all they can vary is the grade of motor they buy and the design of the mechanical components - the gears and bearings in the gear train. They can also cut labor costs by assembling the unit somewhere where labor is cheap and by cutting back on inspection of the final product. The result is a unit which has a small, five pole, motor, nylon gears and bearings formed by running the shafts directly in the servo case. This type of servo - the HS80s and S80s of this world - is very cheap to make but despite this it is actually very adequate for many uses. It will have flaws - the motor will be relatively low torque so it may be geared down more to get this up, resulting in slower response. The nylon gear train will not take shock loads well and may break teeth resulting in erratic operation. The case will wear, especially if the shaft loads are high, which will misalign the geartrain, further straining the gear teeth and predisposing them to break. The motor commutator and brush assembly wil be less likely to tolerate the motor stall current of a half ampere or so and may get burn spots on it, causing intermittent operations (the Futaba S133s were notorious for this). This doesn't mean that the servo is 'bad' but rather gives us an idea of the sorts of situations where we should and shouldn't use it. If we pay more then we'll get improved bearings, with maybe a bronze sleeve for the intermediate gears and a ballrace for the output shaft metal and a better quality multipole motor (the more 'poles' the motor has the better it starts resulting in more torque, faster response and less chance of getting 'dead spots' on the commutator. It may also have metal gears but these are not necessarily a feature of a 'quality' unit. It is much more difficult to fabricate precision gears out of metal than nylon and metal's lack of 'give' and tendency to corrosion means that a small imperfection or particle of dirt that would go unnoticed with nylon gears could cause significant binding in a metal gear train. Likewise, a ball race on an output shaft in



Inside a Servo

not a necessity in a quality unit, in fact it might be a cause of problems if dirt or corrosion products get into that type of bearing. We use features like metal gears for situations where we think that the servo may be subjected to 'shock' loads - flaps, for example. We use ball races in situations where we expect the axial loads to be very high (there's probably nowhere on a typical glider where we need to use this type of servo). Probably the only way to determine which servo is right for a particular application is our collective experience - we use them get to know them, and pass on what we know.

Once we've installed a servo we need to remember that it will wear over time, and that wear may eventually cause a 'major malfunction' so we need a reliable way to determine whether a servo needs close inspection without dismantling it first. Fortunately there is such a mechanism. If we monitor the current drawn by a servo while it operates we can tell a lot about what that servo is doing. In the March newsletter we published a table showing the current drawn by typical servos while idling (about 60mA), while moving under no load (about 120mA) and while trying to move while stalled (about 600mA). If we put a current meter in the power line to the servo - or even to the receiver - then we can monitor this current. If it shows a significant deviation from these typical values or if similar servos doing similar jobs show a significant difference in the current they draw then this is an indication that something needs examining further. If the current drawn drops significantly when the linkage is disconnected then that linkage is binding and should be examined. (Be especially careful about binding or 'hitting the stops' at the limits of travel - although you may not use this amount of movement if the servo gets there for any reason the current drawn from the battery will increase rapidly.) If the current drawn by this disconnected servo when traversing varies over its travel - especially if it 'jumps' - then its quite likely that there is a problem in the gear train or bearings. Likewise, if you hold the output horn lightly to load the servo and the current 'dips' as it moves then you've got a missing tooth (you should be able to hear the motor note change as well).

Lastly, we should be aware that servos don't always 'track' consistently - that is, individual servos may have significant differences in shaft position for the same control input. This could be important in situations where control surfaces such as flaps really need to move together. We may find that we have to select pairs of servos to use in this type of application. ✸