SUPER RUDEVATOR

by H. H. OWBRIDGE

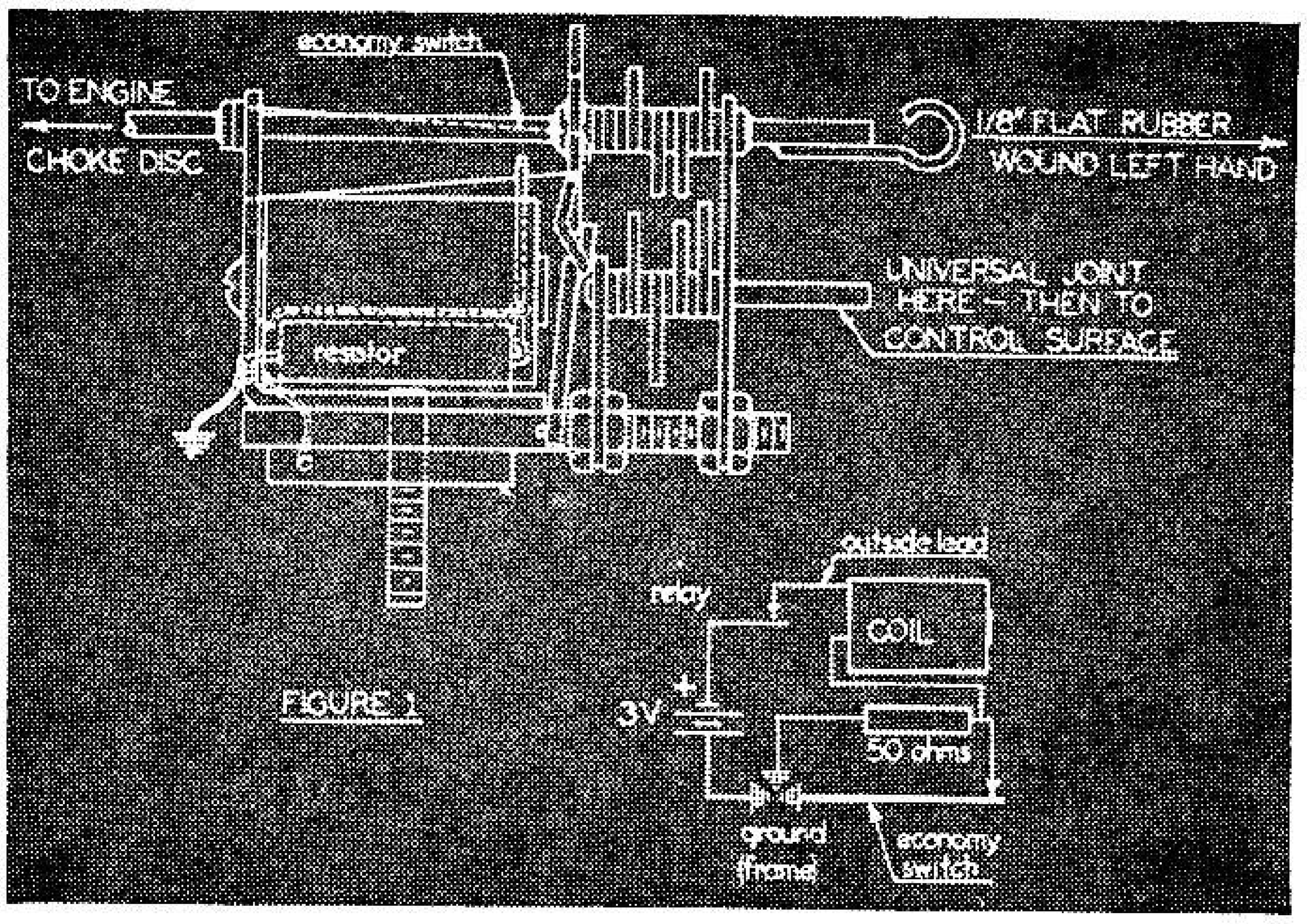

FIGURE 1

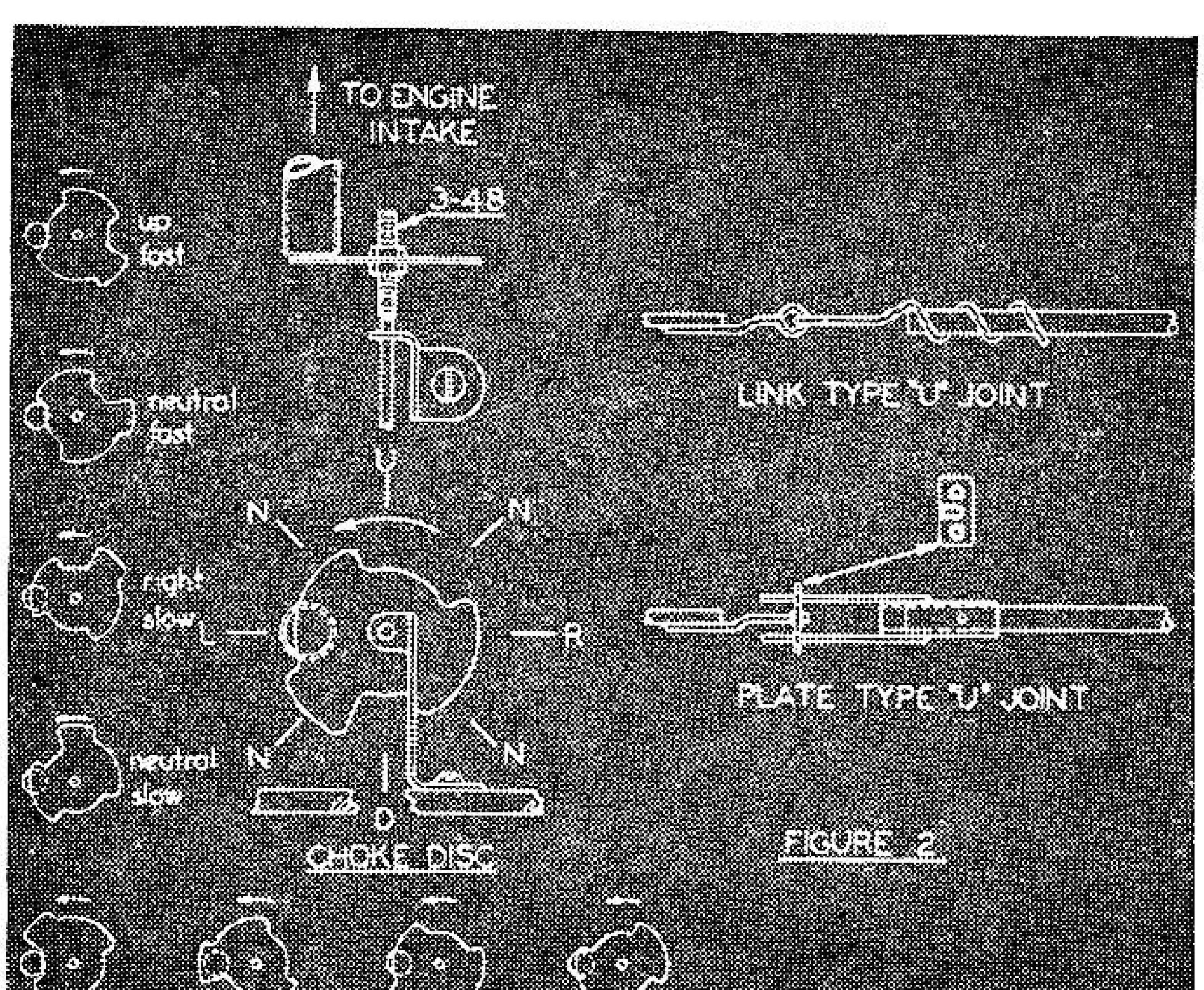

FIGURE 2

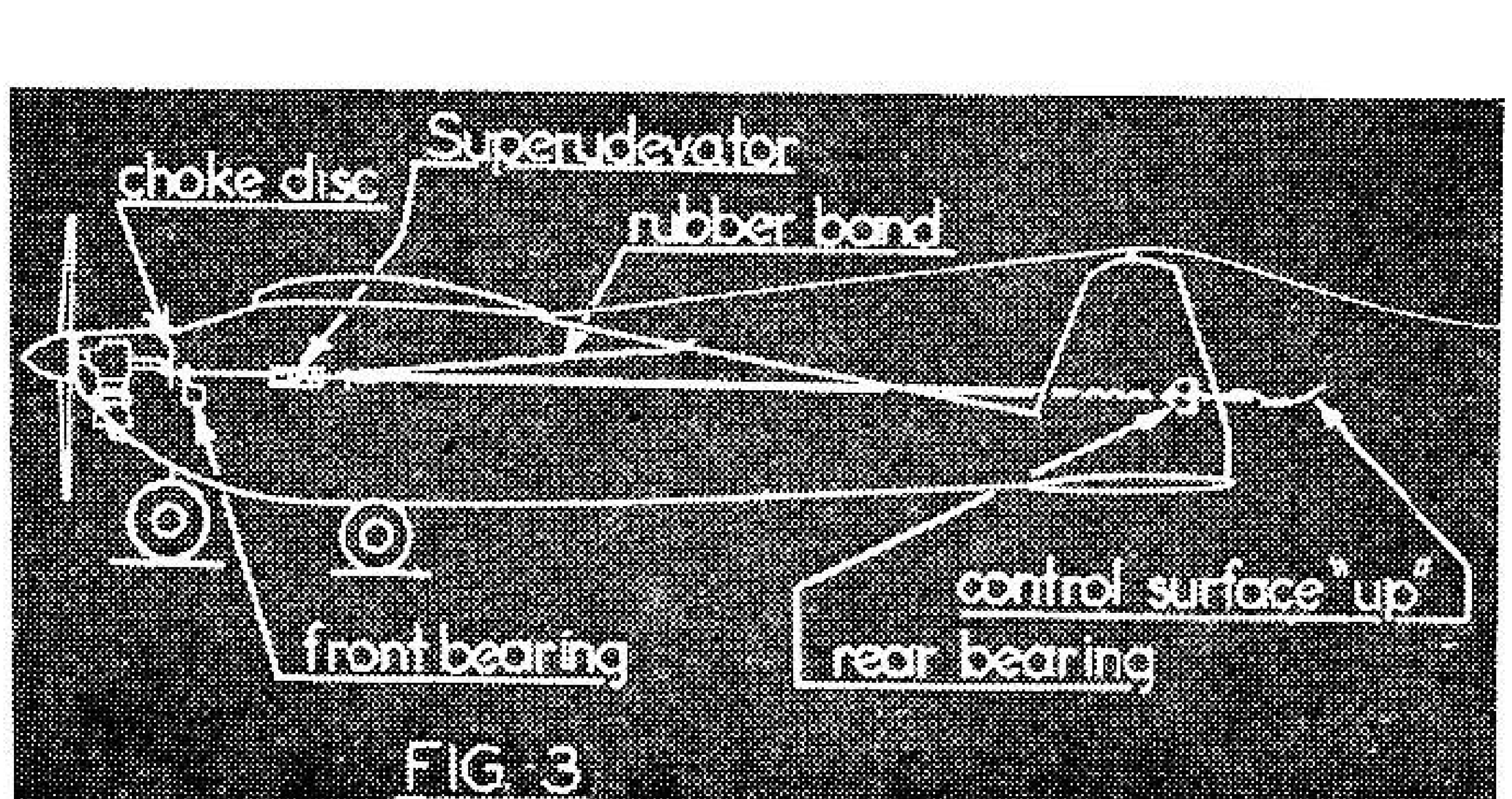

FIG. 3

RUDDER, elevator and engine control—these three have long been recognized as the ideal combination for the proper control of a model by radio, but their order of importance is not just that. On a 100% basis, their order of importance is more nearly as follows: rudder 60%, engine control 30%, and elevator 10%. Other opinions may juggle the percentages a little, but it is not difficult to agree that if radio control is to be kept simple and therefore practical for the majority of modelers, engine control is easier to get than elevator control, and much more useful.

The well-known control unit called *Rudevator* includes a form of elevator, but the only reason this type of elevator is considered worth its weight is because it can be had for practically no weight at all. We have long wished that engine control could be had for as little additional weight and complexity as this elevator control. After trying more experiments than we care to remember, the idea finally came through. The final idea is so utterly simple compared to some of the extremely fancy solutions we have tried, that the whole thing leaves us feeling somewhat foolish. When finished, it was obvious that the reason this idea wasn't thought of long before was simply because the details of flying a radio controlled model were often improperly valued in our minds. This is a common occurrence in the development of any machine, large or small.

We call our new control unit *Superudevator* in order to separate it from its older brother, *Rudevator*, which had at best only an indirect means of controlling engine power. *Superudevator* gives rudder and elevator action by means of the free-floating rotary control surface just as did the *Rudevator*. But in addition, the unit also gives a two-speed engine and cutoff without the use of any additional coils, magnets, motors, switches, thermal delays, relays, escapements, valves, pressure tanks or what-have-you. We finally got the three major radio controls on one simple single-channel escapement unit that is rugged, reliable and only weighs 1 oz.

A look at Fig. 1 will show how it operates. As will be seen, the parts are the same as used on a *Rudevator* except that their positions are changed so as to give an escapement with a take-off shaft at both ends instead of at only one end. Present *Rudevator* owners can rearrange the parts themselves. Notice that the armature and the bearing plate nearest it have been cut off just above the coil core and a new armature stop has been added. The lower shaft, which used to be the rubber-powered escapement shaft, is now the control surface shaft which runs back (by extension) to the rotary control surface. The upper shaft now becomes the escapement wheel shaft and is rubber driven (by a loop of 1/8" flat) from the rear, while its front end goes forward to the engine to drive what we call a "choke disc." Let's talk generally about the unit before going into installation details. The choke disc can be stopped in eight positions—four with transmitter ON and four with transmitter OFF. So, we merely shape the choke disc to give the power control we want. Others may differ but we personally prefer full power on up, neutral after up, and down. Part power is on all other control positions except neutral after down, which we make cutoff. So a typical choke disc pattern (Fig. 2) has a single radius for part power. From this radius a cutout is made at the proper locations to let full air into the engine for full power and a bump is made (at the neutral after down control position) so that the engine will be choked dead if the disc is stopped here for a few seconds.

Referring back to Fig. 1, it will be seen that another simple device has been added to warrant the distinction, *Superrudevator*. This is a very simple switch that is driven by the escapement wheel; hence it has plenty of power to be reliable. We call this a "current economizer," and it certainly is. As you know, the escapement of this unit is the self-neutralizing type which means that for Neutral, you simply turn the transmitter OFF. This is a very helpful and important point in flying a ship, but it also means that when holding a control with the transmitter ON, current is being drawn continuously from the batteries. The economizer switch really gets rid of this trouble for all time. You can literally hold a control all day on two pen cells. The escapement coil draws about 300 ma. for the first instant that the receiver relay closes. But almost immediately, the escapement wheel on the unit flies over and opens the economy switch. This forces the current to go not only through the coil, but also through a 50-ohm resistor. Thus, what starts out as a 10-ohm circuit, quickly becomes a 60-ohm circuit and current drops from 300 to 50 ma. and remains there as long as the control is held. It takes 300 ma. to draw the armature to the coil but 50 ma. is plenty to hold it there. The important thing is that the armature must get to the pole before (not after) the current is reduced. Otherwise the device would be very unreliable and difficult to adjust.

For installation details, let's assume we are putting the unit in a *Rudder Bug* or one of its many modifications, since that design is so airworthy and popular. Fig. 3 shows a *Rudder Bug*

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Superudevator

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outline. As will be seen, *Superudevator* is not mounted at the tail like *Rudevator* was, but up in the cabin. A very good engine is a McCoy 19 or 29 since it is a high performer with a rear intake; the rear intake is not necessary. If your engine has a crankshaft intake, it can be adapted around to the side or rear of the engine with aluminum tube and rubber hose so as to reach the choke disc. However, we have found that an engine like the *McCoy*, which was designed to run at high rpm, is better for two-speed in radio control because it gives a greater rpm difference between low and high rpm. And it is not the low rpm alone but the difference in rpm which says whether you are going to have low enough power to do a power-on touch and go-landing or not.

The final adjustment is in the choice of propeller. Mount the unit on either side of the cabin and block it up in such a position that a direct drive extension shaft can be run to a point near the engine intake. It is best to install the choke disc bearing bracket and shaft, then install the rotary control surface bearing bracket, rear shaft and control surface. Shape and install the choke disc last. This is done so you can coordinate the shape of the choke disc with the actual control positions. The shaft to the choke disc can be 1/16" brass or 1/32" music wire. The shaft to the rotary-control surface can be 1/16" brass (brazing rod), 1/4" rounded balsa, 1/8" aluminum tube or 1/8" hardwood dowel for most of the way and 1/16" brass rod at the rear end. The shafts should be as straight as possible. A universal joint is used at the control unit end of the rear shaft so that accurate alignment of the shaft is not necessary. Two types of universal joints are shown in Fig. 2. Backlash in the rear shaft due to the universal joint, does no harm. But in the choke-disc shaft, backlash might cause trouble so a direct drive is preferred here. Don't mind if the choke disc cannot be located at exact right angles to the engine air intake. Insert a short piece of roughed aluminum tube in the intake, retain it with plastic wood (if a *McCoy*) and file the end so it fits close and snug to the face of the choke disc. The choke disc can be soldered to its shaft, but it is best to mount it as shown for easy removal for shaping by trial and error. Good material for the choke disc is .005 brass or .010 aluminum. It should fit as close as possible to but not drag on the intake. Some flexibility of the disc helps as the engine will then suck it against the intake on the intake stroke. Run the engine and adjust part power by bending the choke disc bearing bracket in or out so that the choke disc covers more or less of the intake as required. Then check the full power and cutoff positions. Either glow plug or spark ignition can be used. We prefer the simplicity of glow plug and get better two-speed results with it. As usual, of course, the stops on the control surface shaft of this unit can be heated with a soldering iron and rearranged to give the desired difference of setting between right and left rudder just as on the old unit. In fact, for those who prefer the simplest rudder control alone, the elevator stops can be placed so that the control gives either two or four positions of rudder, and no elevator.

One interesting point about the choke method of power control on a glow plug engine should be mentioned. We used to think it was sloppy and used excessive fuel, but measurements showed that the engine actually uses less fuel when partly choked than when wide open. The difference is that when choked, it doesn't burn all the fuel and the wet exhaust makes it appear as though it was drawing fuel from the tank at a greater rate.

Before closing, a few comments on why we place elevator at the bottom of the list of the three most important radio controls. First, comes rudder which we all agree is by far the most important. Besides doing all the simple maneuvers in a horizontal plane, you can also spiral and loop with rudder alone. Two-speed engine control is important because it is the most simple and effective altitude control. You don't have to use such a low-power engine or such a short fuel supply for fear your ship will climb away and get lost. You can have a nice healthy amount of power for climbing quickly when necessary and you can cut off your engine when you want without having to wait for the fuel to run out. Still more important is the fact that engine control makes it possible to go after that exciting maneuver of power on touch-and-go landings.

But look at elevator. If it were a proportional or trimmable elevator, it might be useful for screaming dives and consecutive loops, but the weight and complexity it takes to get such an intelligent elevator is entirely too high. If the elevator is the step function type that gives only full up or down, it is only good for violent and uncontrollable maneuvers in a vertical plane. A step function rudder is different. You can turn it On and Off for different lengths of time and get different results although a step function elevator that is strong enough to hold a ship in a considerable dive against the pull-up force of the horizontal stabilizer cannot possibly produce smooth flight. Worse yet, assume that this step function elevator is of the cyclic type wherein you must go through up and down elevator to get other controls. Then, if the elevator is strong enough to produce a screaming dive, what do you have when you go through it? A violent nose-up or nose-down pitching moment that would be very annoying. The elevator on *Superudevator* is just such a step function, cyclic control, but it is not strong enough to cause trouble when passing through it. It is only worth its weight because it weighs so little and because it is very handy for doing whip stalls, flaring-out on landing, taking the zoom out of a recovery from a sharp turn, mushing-in for a short landing and such maneuvers. It can also be used for increasing speed while flying up wind now that the economy switch has been added. In short, we like it because it gives you something extra for almost nothing in added weight or current drain.