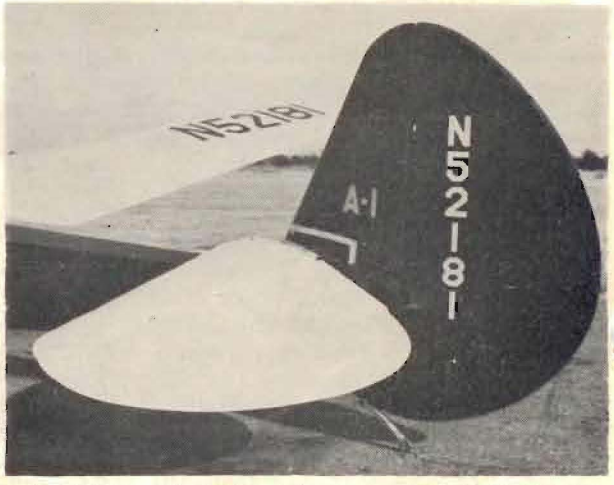
fied so as to have both better stability and lower elevator effectiveness. An immediate approach appeared to be a reduction of the leverage of the control stick so that a larger travel would be required. However, such an approach has the disadvantage that stick forces will be correspondingly reduced. After some computations it was found that removing of the aerodynamic horn balances on the elevator and reattaching them to the stabilizer would increase the stick forces as well as reduce the elevator effectiveness. By doing this, the stick leverage could be increased by 33% and the final stick forces would be of the same order as on the original ship. Moving the horns to the stabilizer reduced the elevator effectiveness to 1.5, and by increasing the stick leverage, the total elevator effectiveness was reduced to 1.1. In Fig. 1 are shown the stick movement curves for the Flat Top with elevator aerodynamic balancing horns removed and with stick leverage reduced. Curves for the C.G. positions are shown. With the C.G. almost on the spar (datum) the sailplane possesses characteristics every bit as good as the Olmpia. With the C.G. 3" behind spar it appears to have good control characteristics at low speeds but a somewhat poorer stick motion at high speeds. For a research sailplane it will be desirable to load the sailplane so as to keep the C.G. near the datum. Comments by pilots including Paul Tuntland, Dick Johnson, Dick Lyons, and Ray Parker have been most favorable with respect to these characteristics.

BEFORE. A standard LK empennage, showing balance surfaces, and drag producing gaps.



and AFTER. Flat Top tail group, with balanced surfaces moved and gaps closed.

It might be mentioned that in additoin to the aerodynamic balance and stick linkage changes, another change was made which adds to the desirable "feel" of the elevator. The elevators were completely statically balanced with a bob weight attached to the rear stick after cutting the stick off, and welding it so as to extend horizontally toward the rear of the ship. This feature is most appreciated when flying in turbulent air and trying to maintain a constant airspeed to high accuracy.

In the paper previously cited, mention was made of Gene Miller's report that some tip stalling appeared in his Flat Top. We have carefully investigated this phenomenon since building our first three Flat Tops. Not one of our test pilots found any sign of tip stalling. In fact stall tests show the ship to remain with wings level and even retain aileron control through the stall. However, there is a behavior which could have been mistaken for tip stalling. At high lift coefficients the adverse yaw of the aileron system on the TG-4a is quite extreme reaching as much as 30° before the ship starts coming back toward its original heading. This behavior is particularly bad when a fast turn at slow speed is to be made. In a research on automatic yaw control the adverse yaw was found to be so great that coordination was not possible even with full rudder.

In an effort to overcome the adverse yaw we are modifying the aileron control system so as to increase the differential ratio from 1.5 to 6. Computations show that the rolling time to 45° bank will be materially reduced if the adverse yaw is removed even though the total aileron deflection consists only of the upwardly deflected aileron. Later on we may increase the up-aileron travel from 14° to 30°, and thus get increased rolling velocities. This will be possible since we have already removed the two static balances in each aileron and have found no tendency toward flutter at speeds as high as 110 mph.

An additional change in the controls on the TG-4a appeared warranted after some flying with the standard job. Since the rudder forces were found to be quite small, the aerodynamic balance was removed and attached to the fin. This change does not increase the rudder control forces so that one has to stand on the rudder, but it does give a "feel" to the rudder.

The directional stability of the original TG-4a was found from the yaw tests to be rather poor in the region above zero yaw. This was most