R/C COUPLED FLAPS

SCEPTER

Chuck Hayes holding the Scepter. This remarkable plane foreshadows a trend design in which the airplane and the control system are engineered as an integrated unit.

With flaps and elevators coupled — stunting is smoother, landings slower, and square maneuvers are possible.

BY CHUCK HAYES as told to Glen Spickler

SCEPTER has been flown and developed to its present, refined state over a five-year period by servo man Chuck Hayes. At first glance Scepter may appear to be "just another shoulder wing multi," but take a closer look and read on.

Chuck is the type of flyer who likes to do Immelman turns on take-off and outside square loops with the bottom leg about 3 ft. off the ground. It goes without saying, that even if we assume that the flyer is qualified, it takes a model somewhat better than average to perform consistently in this manner. I will cover some of the important points of this design and attempt to explain their functions.

The most obvious feature of Scepter is the use of flaps. Contrary to normal R/C practice, these are coupled to the elevator as per U-control. This coupling gives more benefit than might be appreciated at first. An obvious ability to perform good square maneuvers is only of secondary interest in this arrangement. Picture a force setup with full symmetrical surfaces and no decalage; now to fly, this will require slight up trim which, in turn, gives down flap trim. The net result is washed-out wing tips. Turn the model upside down and the identical condition will exist. This condition will also exist, only to a much greater extent, in both inside and outside loops. Now let's imagine a landing approach. As the model slows down, more and more up elevator is used; the washout in the wing tips increases proportionately and allows full aileron control to be maintained right up to almost zero flying speed. This must be seen to be truly appreciated. On take-off there is less apparent zoom as the decalage change, due to flaps, allows the fuselage to remain more nearly parallel to the ground. The climb angle will be the same but will appear much less.

One last feature, while the flaps provide exceptionally square maneuvers when required, there is almost no increase to control sensitivity around neutral. In fact, Scepter is very docile anywhere close to neutral.

Scepter, instead of being a shoulder wing, is a true mid-wing. If the wing with dihedral (5 degrees per panel) were drawn on the side view, it would show the thrust line passing through the center of the ailerons. This feature, coupled with an airfoil that has short CP travel (airfoil is from a series by the author); thick, symmetrical vertical and horizontal stabilizers; no aileron differential (differential reverses when inverted) and no engine offset, provides axial rolls that make the model appear to be flying on a wire. Very little elevator movement is necessary to maintain a level, rolling attitude.

The Scepter also has a relatively large amount of lateral area near the CG. This helps in four-point rolls and knife edge flight. Placing the battery and radio above the wing in the canopy raises the CG and helps to keep the nose up in a turn. This also helps make the rolls axial.

This is not a model for the beginner. Consequently, I will only touch on the high points of construction. The fuselage is not too different, so it is enough to say, "build it light." The balsa sheet should be approximately 6 lb. B or C grain. The block balsa should be as close to 4 lb. material as you can find; stringers and di-

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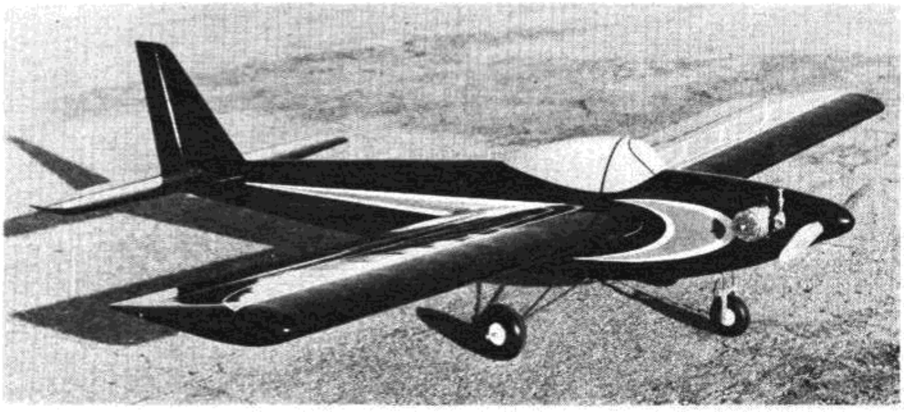

These views of the midwing demonstrate how flying and control surfaces are symmetrical about the thrust line. Coupling the flaps produces more stable and powerful pitch responses without making elevator control more sensitive. Carved canopy area provides increased lateral area and houses some radio weight to raise CG location.

Scepter

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agonals should be light but stringy.

Wing ribs are cut so that the back portion behind the front spar is a straight line top and bottom as shown on the plan, excess material is sanded off after the leading edge sheeting is in place. This allows the wing to be built flat on a building board with either side up. It is absolutely necessary to have a flat building board as the construction provides a very rugged structure. Any warps built in will be almost impossible to remove. The easiest sequence of operation is to pin down trailing edge sheet, attach spar to it, and then ribs, pre-shaped and notched leading edge, rear webbing, top rear spar, top rear sheeting and the top front spar and sheeting. Then invert the wing and install front webbing, spar and sheeting. Now is the time to sand the excess wood off the ribs. Saw or sand center ribs to correct dihedral angle and glue wing panels together. I have not mentioned installation of miscellaneous plywood doublers, etc. It is assumed a competent modeler will do this as necessary. I believe you will like this construction after you try it. Although slightly more complex, it is light, rigid and strong.

The stabilizers are easily built if the correct sequence is used. Make a simple template to cut the wedge-shaped ribs then cut a piece of light, C-grained 1/16 sheet balsa that will extend from the rear spar to the high point of stabilizer (shown by dashed line). Pin this to a flat building board, attach trailing edge spar, cut ribs to correct length and attach to bottom sheet and T.E. Now take another piece of 1/16 sheet identical to bottom piece, glue on top and add pre-shaped L.E. The curved portion of the ribs may now be roughed out with a template and sanded to shape — use a little extra care here. Pin stabilizer back onto board, sheet leading edge. When dry, turn over and pin back to board; sheet the other side. This sounds somewhat difficult. It isn't, and the construction provides a light, rugged, airfoiled stabilizer. It might be a good idea to build the vertical stabilizer first (same airfoil). It is smaller and consequently easier to build and will provide a little practice before starting on the horizontal stabilizer.

The Scepter in the photos was pre-doped with approximately five coats of butyrate; sanded lightly; silked and clear doped. Dope and talc were then used to provide a smooth surface for the color coats.

Weight should be around 6 to 6½ lbs. ready to fly. Balance point should be at the front spar. (Later this can be moved back ½ to ¾"). Adjust elevator movement to approximately 75% of what you normally use; flap angle should be approximately ½ elevator throw. Flap and elevator angles can be changed later to suit the flyer, but this is a good place to start.

Best of luck with your Scepter. A lot of time, thought, and effort went into developing this design. You will be pleased with its performance.