THE THORP TIGER

Put a tank in this Tiger and you'll have a going machine! The real Tiger was the pet project of John Thorp, one of the most prolific, famed designers in the airplane industry. The model's designer is equally noted for his many radio-control scale craft.

By R. JESS KRIESSER

In 1963, at the annual fly-in of the Experimental Aircraft Assoc. in Rockford, Ill. amid all of the excitement of this biggest event of the year for amateur aircraft builders, a small, slightly-built man, with hair thinning somewhat around the temples, was calmly at work riveting some pieces of sheet metal together with a hand riveting tool. He was working under the most primitive of conditions, with a few helpers to line up the parts, and using the Pop Rivet tool, which resembles a pair of pliers. Rivets were noiselessly applied, and the man didn't hurry at all. He acted like he really didn't care when he got the job done. But at the end of three days, he had completed a fuselage for a small, low-wing, all-metal aircraft combining high performance on low power with the utmost of simplicity in construction.

The man was John Thorp, and the fuselage was for his T-18 "Tiger", latest of a long series of designs to emerge from his imaginative mind. If the name Thorp isn't completely familiar to you, his designs undoubtedly are, for John has been busy designing (and flying) aircraft for many years. Among his design accomplishments are the Lockheed P2V Neptune, the Lockheed Little Dipper and Big Dipper, the Thorp Skyscooters, all of the aircraft produced by Fletcher Aviation, the Wing Derringer, the Piper Cherokee, and the new Beech Tri-Gear D-18. A skilled pilot with many years flying experience, John Thorp has flown just about every design to come off his drawing board, except for the Neptune.

When John Thorp announced his plans to design a new aircraft for amateur builders, he turned the home-built world upside down, for what he intended to do was virtually unheard of at the time. He planned an all-metal ship for sport flying which would be a high-performance airplane, stressed to 9 G's for aerobatic capability, utilizing the surplus Lycoming 125 hp ground-power unit (selling for a little over $100 at the time). It would feature a quick-disconnecting wing for taking the ship home, with simple construction that could be handled by beginners to aircraft sheet metal work, and it would be cheaper to build than any other type of construction. Ordinarily, such expectations would be taken with tongue-in-cheek, or ignored. But not when announced by John Thorp. Hundreds of would-be builders became interested, and before the first T-18 was ready to fly, more than 150 were under construction.

First to get in the air was the one built by Bill Warwick of Torrance, Calif. For his powerplant, Warwick chose the 180 hp Lycoming 0-360, making his Tiger the most powerful of those built to date. With a span of 20 feet 10 inches, and a length of about 18 feet, the Tiger is a diminutive little 2-place airplane, and with the 180 hp engine, it weighs 903 lbs. empty. With the 125 hp surplus Lycoming, it weighs in about 100 pounds lighter.

Warwick's Tiger is a real hot-rod, and according to reports of those who have flown it, it is about the nearest thing to a P-51 they have handled. Acceleration is so great, that when the throttle is firewalled, the occupants get pushed back against their seats before the throttle even hits the full open position. On climb-out after takeoff, Warwick has to hold his engine down to not more than 2,500 rpm so that the Tiger doesn't exceed the red-line speed on climb-out! Even then, it climbs out nearly at cruising speed, with an effective rate of climb of over 2,000 feet per minute, and that's fully loaded! From a stand-still, *(Continued on page 58)*

Poly-hedraled wings with eight degrees on each side, add turn stability.

Photogenic lines are not spoiled by the small upright .19—with which power the ship is not excessively fast. How about a dummy pilot?

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next door. By then it was dark and everyone but the crew went home.

I went back another day and worked with the special "clean up" crew doing the crackup and aerobatic work. You want some fun; try to hit a spot on the ground with a Ukie airplane—not close—*on it.* After about eight times I was pooped, the Wizard, fresh as a daisy. We did the aerobatics in the park with a Goldberg "Cosmic Wind" on 44-foot lines. Early in the game I couldn't hear a call from the director, so stepped over for a closer listen. We didn't hurt the tree, but it shredded the outboard panel! A rather ignominious end of an otherwise flawless performance.

This type of work is very educational. One finds that actors and actresses are real people, highly skilled in their profession. It's a tough job, starting before sun up and ending after dark. The crews are tops in their field, including the crew in the editing department where film, script, and sound come together into a logical sequence of events. I was fascinated at the skill with which each disconnected shooting session was handled to fit into the overall story. It evidentally takes several days of shooting outdoors, several more indoors and a few more days with clean up shots and retakes to put together some 24 minutes of story.

The jury is still out on the show's effect on Model Aviation, but it can't help but be beneficial. Our sport was presented honestly and accurately from a beginner's level, not saying it's impossible, not passing them off as simple "toys." The desire of the producer Mr. James Fonda to present true-to-life stories is very commendable and we owe Screen Gems, Inc. a vote of thanks for presenting our sport to the masses.

(The show was repeated on June 27, 1966—Editor.)

Thorp Tiger

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Warwick's Tiger accelerates to over 80 mph and is airborne in less than 15 seconds.

Best cruising altitude is 8,000 feet, where the Warwick Tiger trues out to 170 mph on only 75 percent power. Speed in the approach pattern is 110 to 120, with final approach made at 90 to 100. Over-the-fence speed is about 80 to 85, with touch-down at 70. At 65, the little ship stalls out cleanly, with fast recovery dead ahead—no wing dropping tendency in either direction. One test pilot, in evaluating the performance of the ship, tried a series of 45-degree banked turns with his feet flat on the floor. No rudder in use, only ailerons; and the ball-bank indicator remained on dead-center all through these tests. Secret of this is the aileron differential set-up.

Those RC designers and modelers who've been debating the proper amount of aileron differential to use will lift their eyebrows quite high at what Thorp did. He uses 10 degrees down with 35 degrees up! Result is that the T-18 is just about the only small aircraft around outside of the Ercoupe that can be flown through turns on ailerons only.

Use of the 125 hp Lycoming engine does not appreciably lower performance. With this power, you won't get Warwick's hot-rod performance to be sure, but takeoff is only a bit longer, with rate of climb fully loaded still at well over 1,000 feet per minute. Cruising speed is only about 15 miles slower.

The poly-dihedral wing, with eight degrees of dihedral in each outboard panel, is a major factor in stability in turns, and is also one of the characteristics of the ship that made it attractive as a model project. Our model of the Thorp Tiger is very accurately to scale, at 2-1/8 inches to the foot, and with the exception of wheel pants, is patterned after the original, built by Bill Warwick. I have adhered faithfully to scale throughout, with only a few minor deviations. Areas of all flying surfaces are to scale, with the scale-size stab, which is just a shade over 15 percent of the wing area.

Only three concessions to scale were made in the entire ship. First was in the airfoil section used. Designer Thorp used one of the modern laminar flow sections, but I chose the NACA 23015 for model purposes. This section has an almost negligible pitching moment, making it very nearly neutrally stable, and has an extremely small center of pressure travel. These two characteristics make it an essentially stable section, that can get by with a minimum of stabilizer area in the tail end to keep the wing airfoil in a stable pitch attitude during flight. Therefore, I thought that this section would enable me to get by with the scale horizontal tail area without any loss in longitudinal stability, and with no penalty in scale points from enlarging the area.

Second concession to scale was in the use of an elevator, instead of the "stabilator" used on the prototype. I did this for obvious reasons, as the stabilizer-elevator set-up is easier to build, and stronger for model purposes. I followed the very same configuration as on the prototype, but simply enlarged the anti-servo trim-tab into an elevator. The third concession to scale is in the tail-wheel assembly. Here I used a Bonner mounting bracket for convenience and simplicity. But since home-builders all have their own pet habits, and there may be a variety of tail-wheel systems installed on Thorp Tigers, perhaps this can be overlooked as an unimportant deviation from true scale.

One final word before beginning the construction. If any of you have been complaining about not having enough room for installing radio equipment in the fuselage, this is one problem you'll never encounter with the Tiger. While visiting in my workshop last winter, John Worth became captivated by the Tiger model, then in an unfinished state. He picked up the fuselage and put it on his head, like a hat!

Wing: The wing to the Thorp Tiger can either be built in three pieces, joining them together and adding dihedral gussets as you do so, or it can be built in one piece. I prefer to build in one piece as I can get a more accurately aligned, stronger structure. A simple jig of composition board, such as Celotex or Homosote, can be made by simply cutting a piece to the proper length for the center section, and cutting two additional pieces for the ends. Fasten the center piece to a flat board with contact cement, and attach the two end pieces with

brads and blocks, blocking them up at the ends to give the proper dihedral angle of 8 degrees. Lay your complete wing plan on top of this jig.

Lay down the main spars first, of 3/16 x 3/8 medium hard balsa, and add the 1/4-sheet dihedral gussets at each joint. Next, block up the 1/8 x 1/4 rear spars, adding the 1/8-dihedral gussets. Glue each rib in proper position, except for the ribs at the dihedral joint. The tabs on each rib permit building the wing on a flat surface and keeping it in proper alignment. Next, add the 1/4 x 3/4 leading edge pieces and the plywood leading edge dihedral braces. Add the 1/8-sheet caps over the rear edges of the rear spars at the aileron areas. While all of this is drying, add the 1/16-plywood dihedral braces at each joint on the main spar and at each joint on the rear spar. Now you can add the rib parts at each dihedral joint, and box off the servo well. After all of this has set up firmly, add the 1/16 sheeting on the top of the wing, and add the catstrips.

When the wing assembly is dry, remove from your building board and turn it over. Carefully trim all tabs from the ribs, and add the 3/16 x 5/8 triangular reinforcement at the center section. Add all 1/16 sheeting on the bottom, and add all catstrips except those at the dihedral joint. Install the 1/16 plywood aileron bellcrank mounting plates, and add the false ribs W4-B. Now add the 1/16 sheet under the aileron bellcrank area, and cut a slot in each for pushrod clearance. Add the tip blocks to the wing, and rough carve the tips and leading edge to approximate shape. Sand them down to final shape, using progressively finer sandpaper as you do so. Installation of the aileron pushrods and bellcranks completes the wing assembly, except for the ailerons.

Ailerons are built upside down, directly over the plans. Lay down a piece of 1/16 sheet and glue the aileron ribs in place on it. Add the front part of 1/8 sheet, and cut the horns from 1/16 micarta while they are drying. Fasten the horns in place with epoxy and sheet metal screws. After they are properly installed, you can add the bottom sheeting on the ailerons, and sand them to final shape.

Tail Assembly: The stab is simple, so no problems in construction should be encountered. Begin by pinning the 3/16 x 9/32 trailing edge spar to your building board, then position and glue each rib to it. Tabs on the ribs help keep the symmetrical section in alignment during construction. Be sure and space the two center ribs to allow a snug fit for the 1/8 sheet fin core later on. Next add the 1/8 x 1/4 leading edge, and the top sheeting of 1/16 medium soft balsa. While drying, cut the tip blocks to outline shape. After removing the stab from your building board, cut the tabs from the bottom of the ribs and sheet the bottom of the stab. Tip blocks are now glued in position, and when the entire assembly is dry, carve the tip blocks and leading edge to approximate shape and sand the entire structure to final shape.

Make the elevators from 1/2 sheet as shown, and set them aside until later. Cut the fin core from 1/8 sheet, cutting lightening holes in the core between the ribs as shown. Add a piece of 3/16-square soft

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balsa on each side of the fin core at the trailing edge, and add a piece of soft 1/8 x 1/4 on each side at the leading edge. Cut and glue all rib-halves in position as shown, and when dry, carve and sand the leading and trailing edge strips to proper cross-section to allow flush application of the 1/32 sheet covering later on. At this time, you can cut the rudder from 1/2 sheet, and set it aside for final shaping later. Add the 3/32 wire yoke and short length of tubing to the rear of the stab as shown, reinforcing it with a small piece of nylon. Now you can glue the fin in position into the slot in the stab, and set the entire tail assembly aside for now.

Fuselage: Because of the extreme width of the fuselage, you cannot make the side pieces by using the side view of the Thorp, for if you do, there will be foreshortening of the fuselage when the sides are pulled together at the rear. A special template has been developed for the sides, to compensate for this foreshortening. Use this to cut the sides from matched pieces of 1/8 sheet, and for assembling all basic parts to these sides. Add the 1/16 doublers to each side as shown, making sure you construct left and right sides. Next add the 1/8-sheet triplers to each side; these extend from former 2 forward. Now add the 1/8 square longerons, top and bottom, and the 1/16 sheet doubler at the stab opening. Add two short lengths of 1/8 x 1/4 at the rear to aid aligning the tail post later. Follow these by adding the 3/32 x 1/4 uprights and diagonal braces. While this is drying cut out and construct all formers as shown, and shape the cockpit floor from 3/16 soft quarter-grained sheet.

Notch the fuselage doublers to receive the tabs of former 4, which help alignment during assembly. Begin assembly of the fuselage by gluing both sides to former 4, and gluing the cockpit floor in place between the sides, and flush against the front surface of former 4. This helps key the entire fuselage for alignment during the rest of the assembly process, and a little care here will pay off in a well-aligned fuselage when completed. Hold the fuselage sides together at the front and rear with a strip of 3/4-inch masking tape, to help in curving the sides around the cockpit floor. Glue former 2 in place. Now start working toward the rear, adding the cross pieces, top and bottom, as you go, and holding the fuselage sides together at the tail post with a piece of tape. Shape the tail post as shown in the top view, and glue it and former 8 in place. Add the 1/16 ply gussets at the rear of the wing opening to serve as reinforcement for the hold-down dowels, and you can then sheet the entire bottom of the fuselage with 3/32 balsa. The very end of the fuselage at the tail post is covered with a piece of 3/32 plywood, to provide solid foundation for the tail wheel bracket.

Add former 3 and former 8A to the fuselage, and you can then sheet the top of the turtleback. After this has dried solidly, carve a bevel into the edge of the turtledeck sheeting and into the top edge of the sides, and sand to a final bevel. Do this carefully to assure a snug fit of the 3/32 sheet sides of the turtledeck, and when you are satisfied with the fit, glue the side pieces in place, carve and sand.

Now proceed to the front end of the fuselage and add the 1/2 sheet blocks to the inside of each side. Make them a little longer than necessary, as you will have to bevel the entire front surface later for snug fit of the nose block. Add a piece of 1/4 sheet to the inside of each of these 1/2 sheet pieces, to aid in positioning the firewall. While this is drying, add the 1/8 plywood landing gear braces to the inside, and box off the tank compartment. Fuelproof the tank compartment with several coats of fibreglass resin before planking the top of the fuselage.

Add the 1/4 sheet bottom piece and the remainder of the plywood landing gear parts. Cut the motor bearers to shape as shown from birch or maple, and glue them to the inside of the nose end, with white glue. Drill them for the mounting plate bolts, and add blind mounting nuts. Then cut and fit the bottom block as shown. Cut and add the remaining cowl blocks to the nose as shown, then sheet the top of the fuselage with 1/8 sheet. You can sheet this in several pieces, or plank it with 1/4 or 3/8 wide strips.

Now bevel the front end of the nose for a good flat fit of the 1/2-sheet nose block. Use of a large sandpaper block will help assure a flat fit. Glue the nose block in place, and add the 1/8-sheet wing saddle reinforcements at the wing opening, and set the fuselage aside to dry before final carving to shape.

Rough carve the fore part of the fuselage to shape with a sharp knife, carefully noting the shape at the various cross-sections. Sand down to final shape, using progressively finer grades of sandpaper until it is satin smooth. Now you can finish the tail assembly. If you want a detachable tail, use dowels as shown, and build up the fuselage fairing out of scrap sheet as shown, placing wax paper between the fuselage and the tail assembly so it won't stick fast while pinned in place. If you want to glue the tail on solidly, you may do so at this time when you build up the fairing. A detachable tail is not a necessity. When the fairing is completed, add the 1/32 sheeting to both sides of the fin, the fairing block at the tip, and sand to final shape. Finish the rudder at this time, too, adding the fairing blocks at the bottom, and carve and sand to final shape to blend smoothly with the fin and the tail post of the fuselage.

Covering and Finishing: Everyone has their pet habits of finishing, so follow whatever happens to be your favorite method. However, be sure to give the entire nose of the ship several liberal coats of fibreglass resin, sanding smooth between coats, before silking the ship. It adds extra strength, and fills in the grain so that the nose resembles a sheet metal cowl when finished. I gave the entire ship two coats of full-strength clear Aero-Gloss before silking, sanding with 400 grit paper before silking. After applying the silk, I applied three coats of thinned-out clear dope, followed by three more coats with talcum powder added. After letting it dry for three days, I sanded it glassy smooth with 400 grit paper, and topped it off with another coat of thinned-out clear.

Three coats of Glidden Daytona White

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('59 and earlier) were sprayed on the entire ship, followed by a wet sanding with 400 grit paper. Two more coats of white were sprayed on, then the ship was masked off and the color applied. Trim was Stearman Vermillion with black striping. At this point, I add wing and tail hold down dowels, and doped them with color dope. After all was dry, I sprayed two coats of thinned-out clear Aero-Gloss over the entire ship. The tubing for the windshield was bent to shape and epoxied in place, and the windshield added. When you reach this point, you're ready to install your engine, and all radio gear.

Flying: The first thing that needs to be said about flying, is that the Thorp is not a beginner's model, but an exact scale model of a very high performance airplane, and needs to be flown much as you would any high performance multi. Anyone capable of flying a Taurus, Candy, or similar design, should encounter no trouble with the Thorp.

The second thing that needs to be said is to make certain that all surfaces are true—no warps, and that all incidence angles and thrust offsets are as specified on the plans. When all checks out properly, you're ready to fly it. Pick a smooth takeoff area, so you can R.O.G. it. You'll find that it tracks very straight on takeoff, with no tendency to wander or ground loop, as often the case is with two-wheel landing gears. The design and position of the gear on the Thorp makes it track as straight as if it had a trike gear on it. It lifts off nicely when flying speed is attained, with gentle application of up elevator. With a .19 for power, it is not excessively fast, even though it has a very small wing area. It has smooth control response, much like any competition multi.

For those who may be skeptical about the small stabilizer-elevator area, you can cure any misgivings you may have by simply adding another rib bay at each side of the stab, which will increase its area to nearly 20 percent of the wing area. The additional area will undoubtedly improve stability, but it is not necessary. I have built and flown several multi RC ships with areas in the horizontal tail of only 15 to 16 percent, and with shorter moment-arms than the Thorp has, with no difficulty at all. One even had a flat-bottomed wing section, which tends more to the unstable side than the NACA 23015 section used in the Thorp. We may tend toward the use of more horizontal tail area than we really need in RC ships.