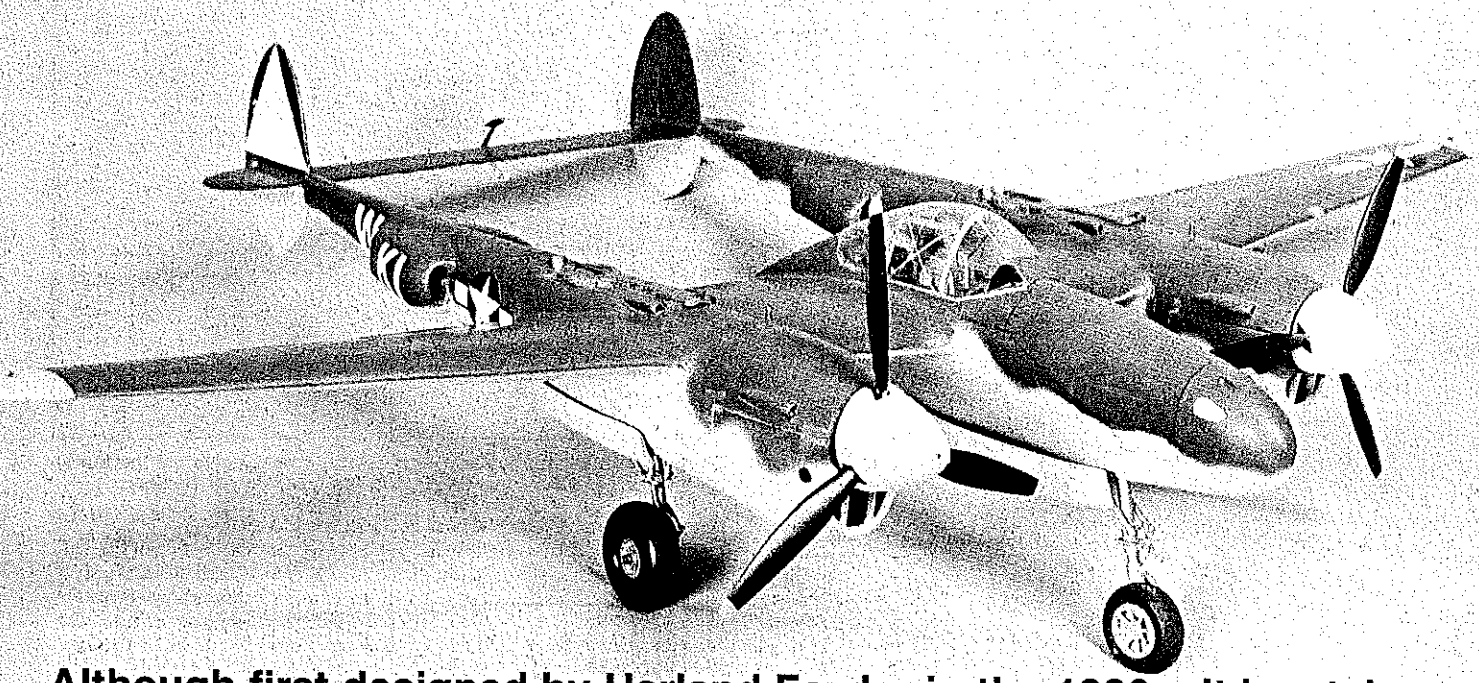
#579

P-38☆Lightning



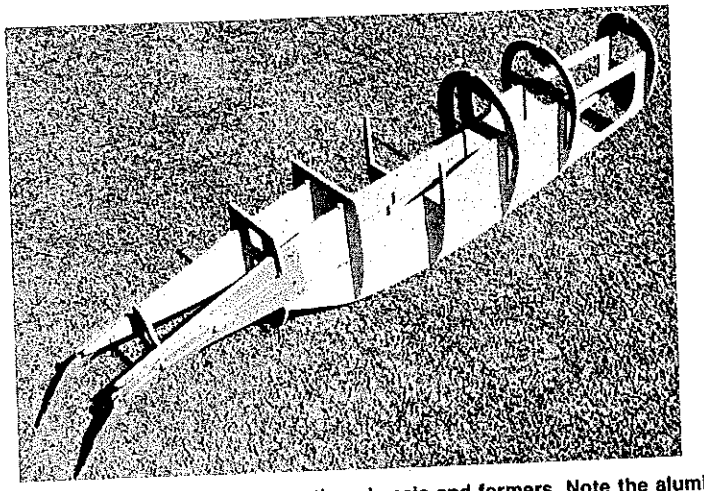
Although first designed by Harland Fowler in the 1930s, it has taken a long time to make his unique flap system work accurately in a model airplane. See what our author did to duplicate them in his Nats-winning Control Line Scale model. ■Jack Stolly

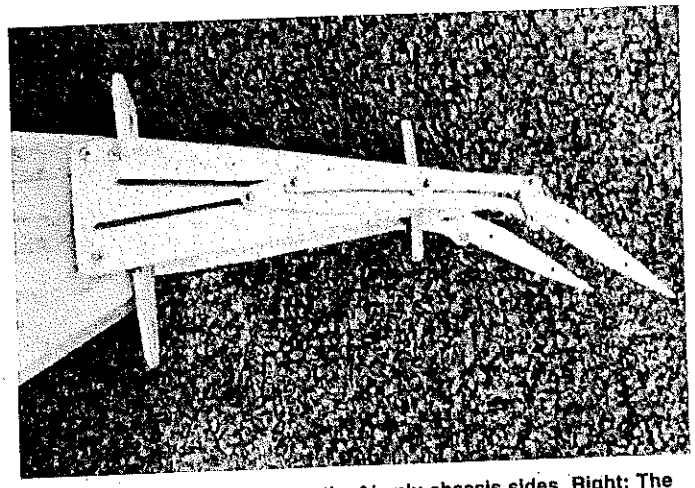
"A STUDY on Fowler Flaps" would have made an equally appropriate title for this article. Fowler flaps and the P-38 originated at about the same time, and the two go hand-in-hand in aviation history. Moreover, the use of Fowler Flaps in the P-38 was what first attracted me to the airplane, and led me to investigate how I could duplicate the system in a model.

Several years ago, while doing some research at the Air Force Museum at Wright-Patterson AFB, I came across a picture of a P-38 in landing configuration with Fowler landing flaps in full down and out position. *Fowler flaps*, I thought incredulously, on an airplane designed in 1937? That was a period in which the Air Corps was still flying fabric-covered planes, and the most advanced "fighter" of the day was the P-26 Peashooter.

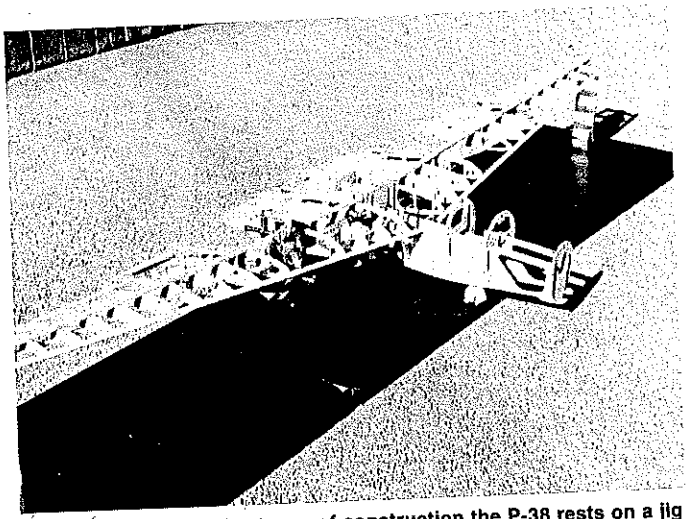
The idea of Fowler flaps was an intriguing one, and the vision of a Scale model P-38 floating in like a butterfly for a landing, Fowler flaps extended, enticed me straight to the drawing board. However, five months later, after countless hours spent in

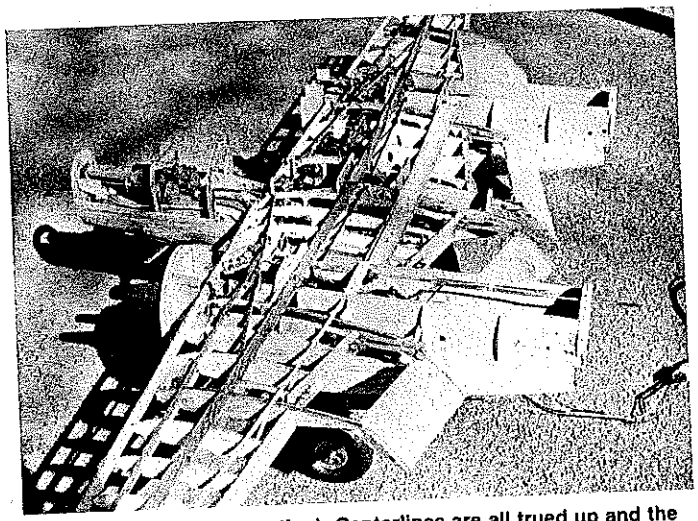
Top: The beauty of the finished project belies the technical prowess required to make the mechanics for the Fowler flaps and retracts work. Above: Our author and his winning P-38 at the Lake Charles Nats in 1986. Model is detailed after the P-38 on display in the Air Force Museum.





Left: The fuselage center section chassis and formers. Note the aluminum flap mechanism attached to the 3/32 ply chassis sides. Right: The Fowler Flap mechanisms attached to the fuselage center section. Using the plans it's easy to duplicate what took many hours to first design.





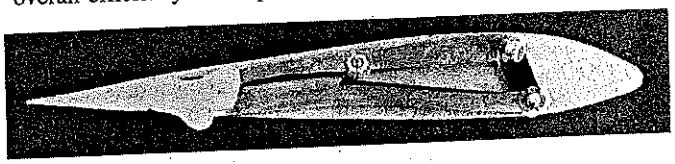
Left: During the early stages of construction the P-38 rests on a jig board (see text for its construction). Centerlines are all trued up and the wing washout is built in at this stage. Right: Basic framework now taking shape, it's time to test out the mechanical operation. With the ground test box connected to the electrical system, the flaps and landing gear are operated to check for any binding linkages or erratic operation.

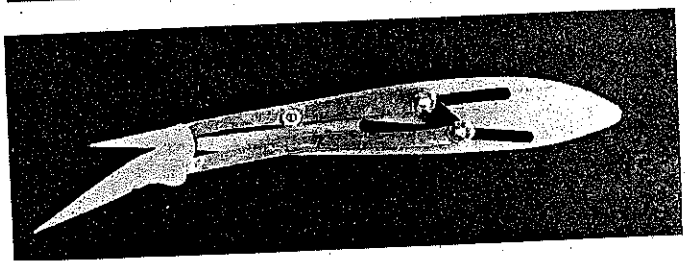
sketching and drawing, puzzling, constructing mock-ups, and just general conceptualizing, I was back to square one. The problem I'd run into was that the Fowler flap installation of the P-38 was *clean*. All of the working mechanisms and linkages were *inside* the wing. Unlike today's planes and jetliners, which have all kinds of pods and protuberances on the exterior surface of the wing to cover up jackscrews and linkages, the designers of the P-38 managed to get everything enclosed *within* the wing, thereby cutting down on drag and increasing the overall efficiency of the plane.

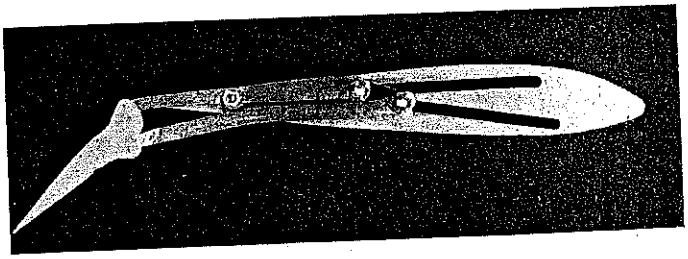
Now I was *really* hooked. I knew I'd have to do more research on the Fowler flap to try to discover how they did it so unobtrusively on the full-size P-38. What kind of crazy linkages did they dream up to move the flap out of the wing and position it behind the trailing edge, and at the same time rotate it down 45°? Who designed it? Was there a man named Fowler?

Yes, I learned, there was indeed a man named Fowler. He was a designer who came to Lockheed from the Stearman-Hammond Airplane Company in the autumn of 1935. Lockheed's chief engineer at the time, Hall Hibbard, liked Fowler's flap idea so well that he convinced Lockheeds's patent counsel to underwrite a patent on it.

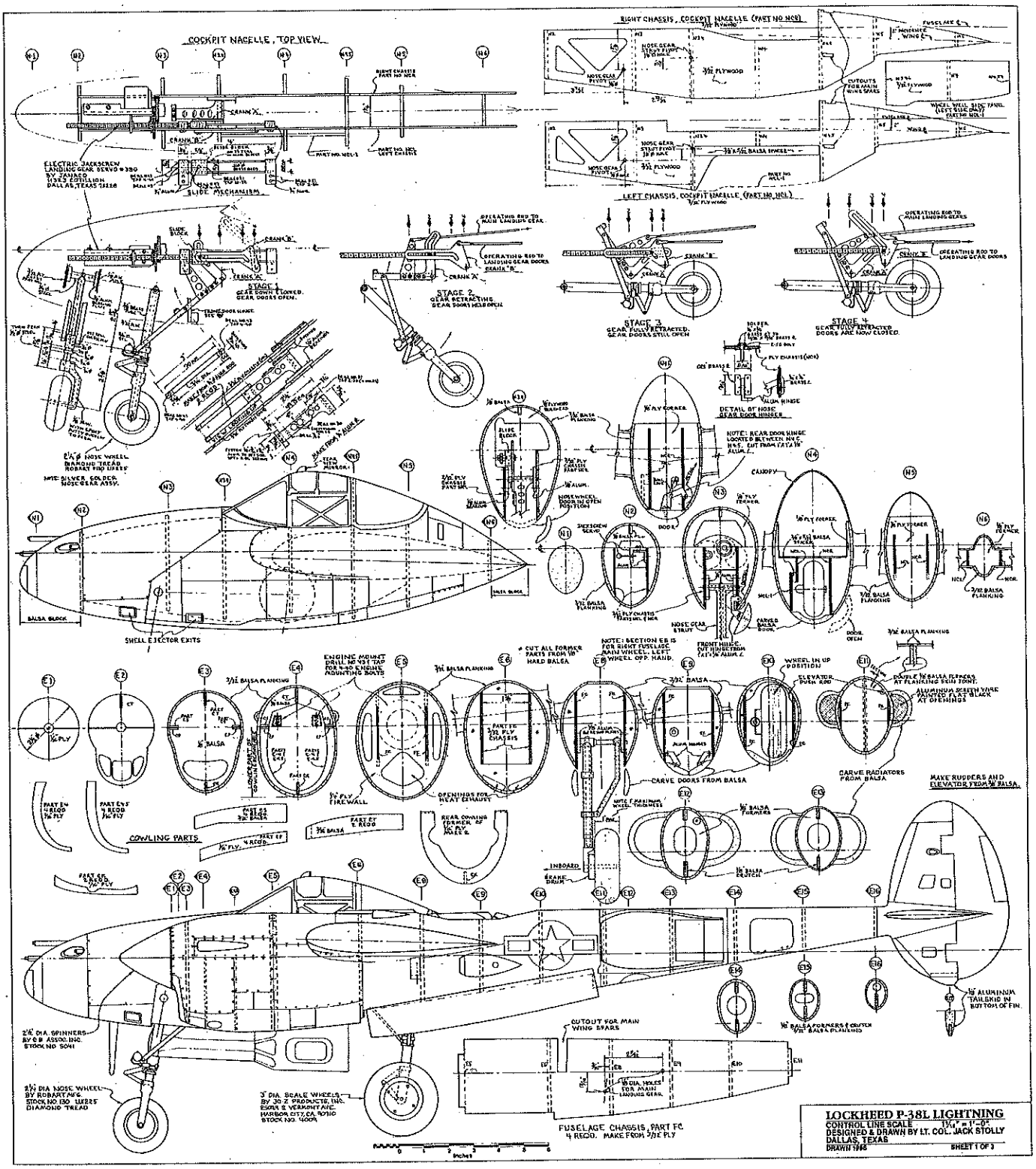
The Lockheed Model 14 Super Electra transport was selected as the test bed for Fowler's flap system. The first flight of the Model 14 with Fowler flaps was made in January of 1937—the same month, coincidentally, that the Air Corps put out its bid specifications for a new type of pursuit plane. Up to that time Lockheed had not been involved in military pursuit/combat planes, but the company jumped into this one with both feet. The result was its Model







Starting at the left and working counterclockwise we see the Fowler flap mechanism go through its cycle. The drag links follow the tracks cut into the aluminum sheeting, allowing the model to accurately duplicate the down and out movement of the flaps on the full-scale P-38. Four sets of these assemblies are then attached to the appropriate ribs (see plans) to actuate the four flaps on this plane.

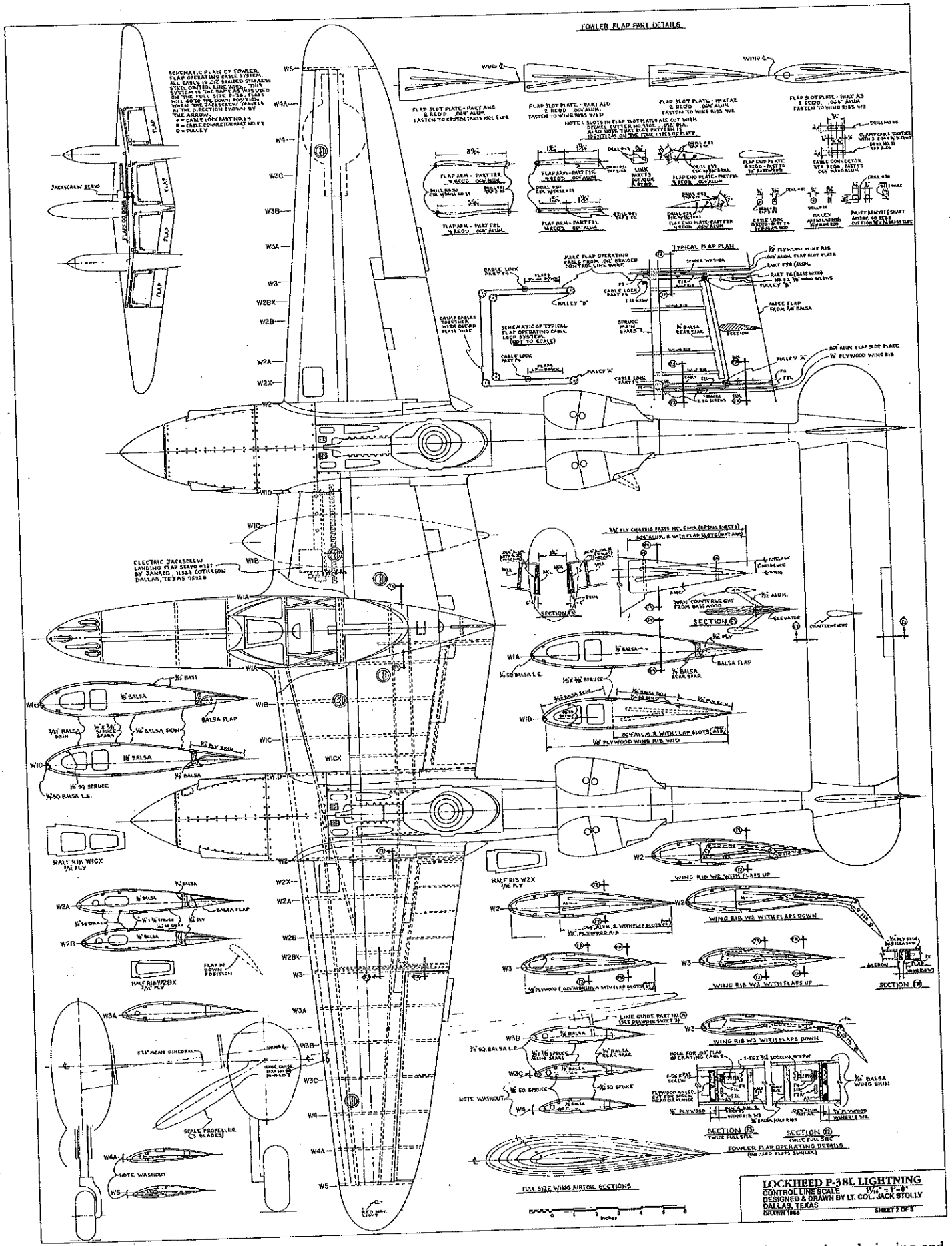


22, designated the XP-38 by the Air Corps, and the Fowler flap was just one of many innovations incorporated in the new design.

Construction of the XP-38 began in July 1938 and progressed rapidly, even though the new plane was loaded with all kinds of "firsts." In addition to the Fowler flaps, it was the first airplane to have butt-jointed, *flush-riveted* exterior surfaces and turbo superchargers, the first to make extensive use of stainless steel, and the first twin engine with counter-rotating propellers. It was completed within seven months and taken to March Field in Riverside, CA for its first flight in January 1939. Just a few weeks later, on February 11, the overanxious Air Corps sent its new machine on a record-breaking cross-country flight from March Field to Mitchell Field on Long Island, NY—unfortunately, only to have it crash on landing. Despite this awkward beginning, the P-38 went on to become the most versatile fighter plane of World War II—but that's a whole different story.

The Fowler flap was licensed to other aircraft companies and was used on such famous planes as the Consolidated B-24 and the Lockheed Constellation, also known as the Connie.

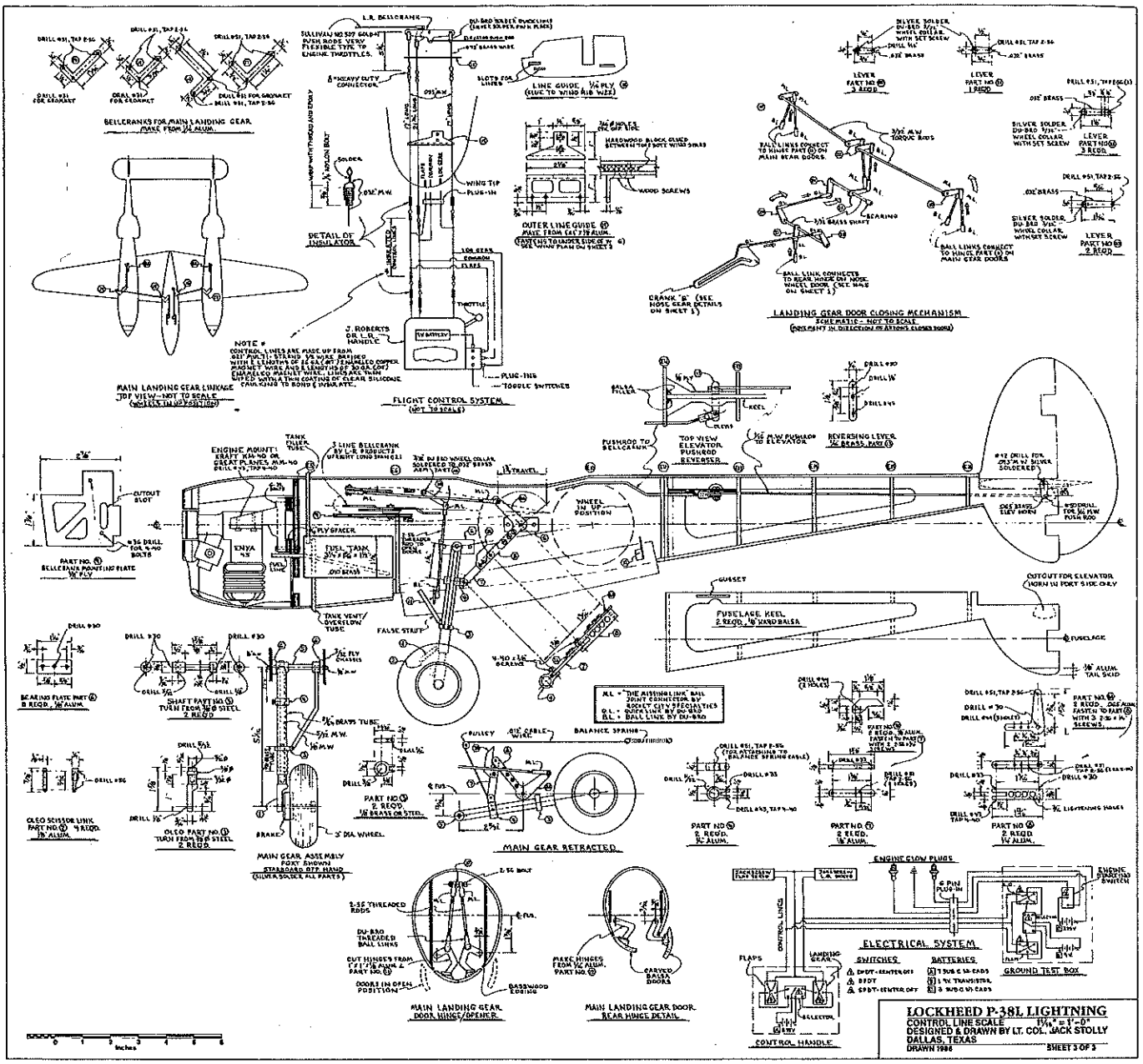
Getting back to the problem of a clean installation of Fowler flaps on a model P-38, I did eventually come up with a solution (as shown in detail on the plans and accompanying pictures), only to realize, ironically, that my system was identical in principle to that devised by the Lockheed engineers so many years ago! The full-size P-38 had tracks and drag links at the ends of each of the four flaps (two inboard and two outboard), to extend and rotate the flaps, just as my model does. Also, the flaps on the full-size version were powered by



means of a jackscrew and cable/pulley system almost the same as on my model. This system not only works in scale fashion but has the added advantage of eliminating flutter because the flaps are locked no matter what position they're in.

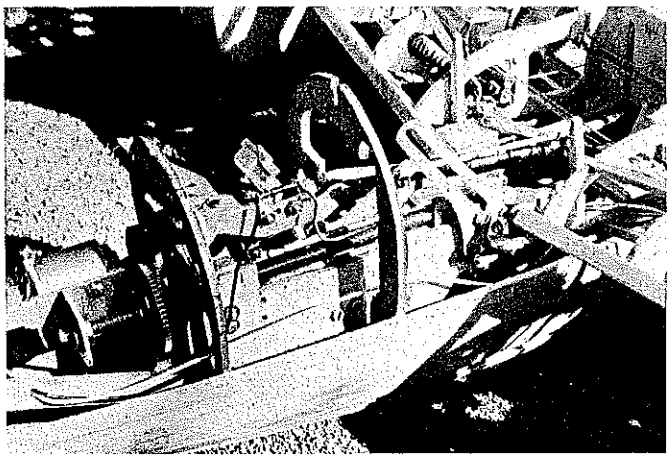
All the work that goes into designing and scratch-building a model such as this one seemed well worth it when my P-38 won

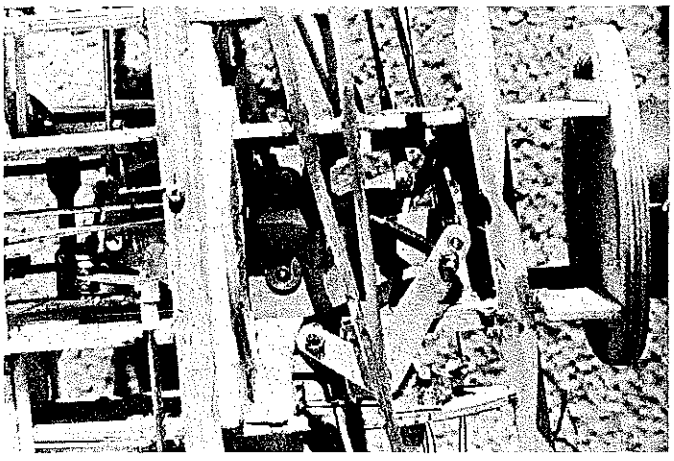
Full-Size Plans Available . . . See Page 170



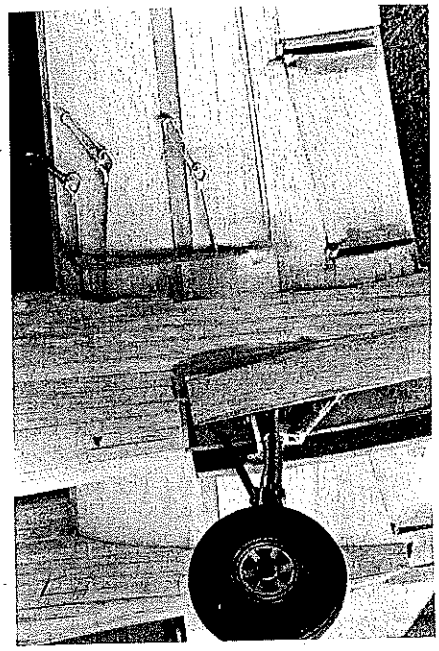
first place in Open Sport Scale at the 1986 Nats at Lake Charles. To heighten my satisfaction, it was the 50th anniversary of AMA and my 50th year in model building. In addition, the P-38 was awarded the NASA Scale Flight Achievement award in Control Line for scoring the highest number of flight points.

Construction. The P-38 as shown on the plans is true to scale, and no deviations from scale are necessary. The only concession you'll need to make is to set the thrust line of the starboard engine about one-and-a-half degrees to the right (toward the out-

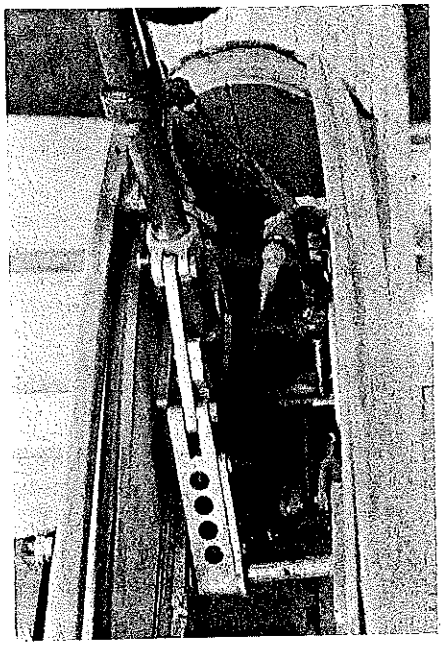




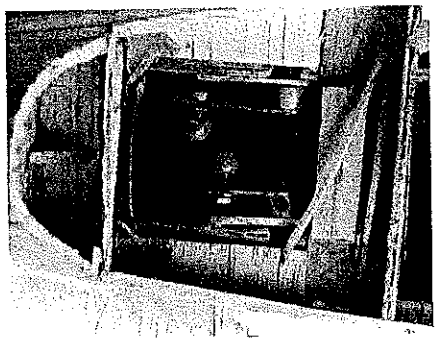
Left: The jackscrew servo in the cockpit nose section operates the landing gear retract mechanism. (Shown here in the door closed position.) Right: The three-line bellcrank is buried in there somewhere, and the right angle bellcrank seen above it is part number 17 on the drawing.



The lead-outs connect just outboard of the left nacelle for a better display appearance. Another set of line guides (not pictured here) are located near the inboard wing tip.



The left main wheel well. Du-Bro ball links connect to the wheel door hinges to close them after the wheels retract. Making the linkages work is a pain but worth all the effort.

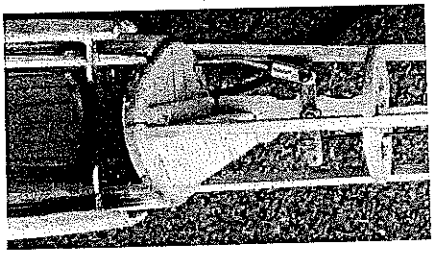


Located just behind the cockpit are these two levers that operate the torque rods connected to the doors on the main landing gear.

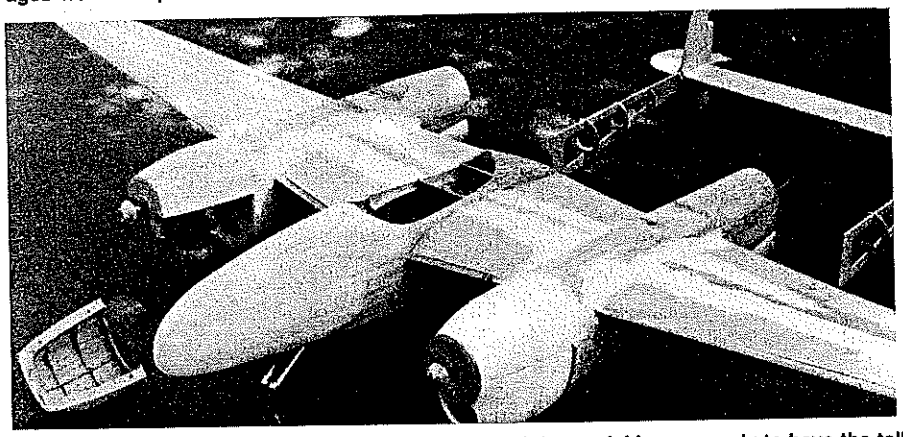
grees of washout in the outer wing panels is to scale, and works perfectly on the model. I have yet to make a bad landing with this airplane, and I'm sure it's because the washout in the wings gives such good stall characteristics.

The only way to build this airplane right is to build it on a jig board. I used a piece of ¾-in. wood, cut 12 x 54 in. It must be absolutely flat and without warps. Leave the

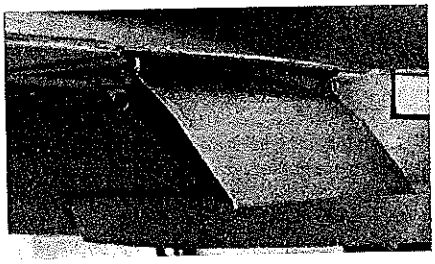
Continued on page 160



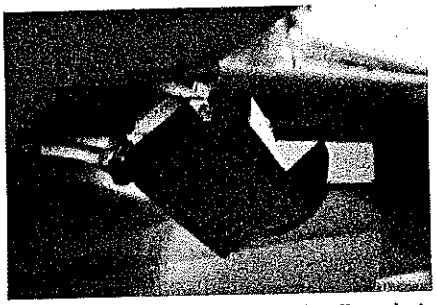
Elevator pushrod reversal was necessary because the left/right bellcrank chosen operates opposite to the direction that's required.



With the front sections planked and the wing sheeted the model is now ready to have the tall sections added. Author says the planked cowlings were easier to make than fiberglass cowls.

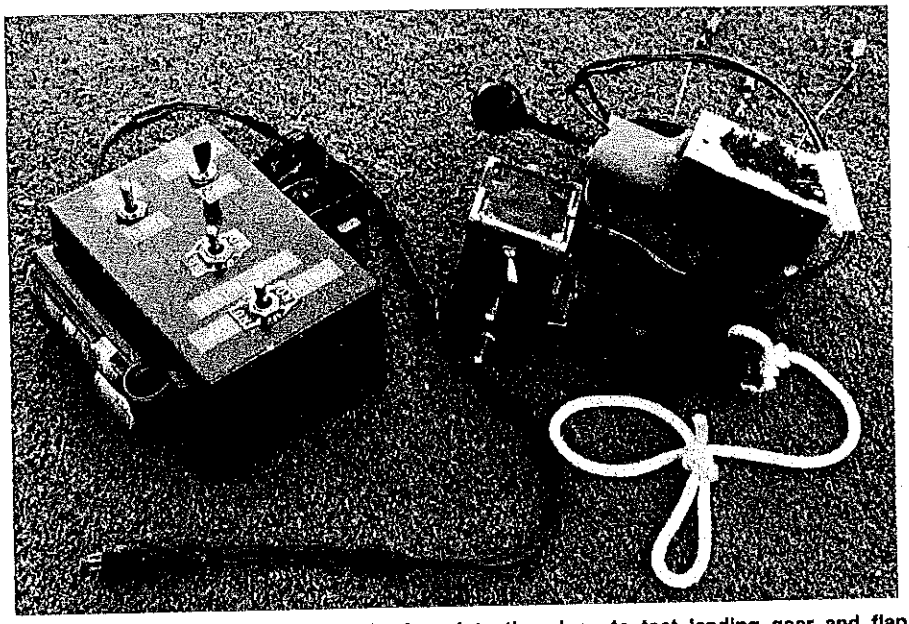


Watching the flaps come out and go down the required 45° is what made this model worth the building time and effort required.



The real challenge to the fowler flaps is to keep all the levers and mechanisms on the inside of the wing as was done on the original.

side of the flying circle), to compensate for engine failure of the left engine if that should occur. No offset of the rudders is necessary, and the plane balances perfectly without any added weights. The two de-



The ground control box on the left plugs into the plane to test landing gear and flap operations. It also fires the glow plugs for engine starting. The flight control handle has throttle three-line operation with battery and switches to operate the flaps and gear during flight.

be reissued, which I mentioned in an earlier column, has become a reality. Thanks to the efforts of Cam Martin, there has been sufficient interest shown in all three models (F-8F Bearcat, F-4U Corsair, and AD Skyraider) for Bob Smurthwaite to produce a limited number of these kits. Price is $36 each ($42 for the Corsair) plus $2 shipping. Anyone interested may contact Bob at P.O. Box 2947, La Grande, OR 97850, phone (503) 963-0596.

Exhaust deflector. One final correction on the origin of the plumbing-fitting exhaust deflector which I described in the August issue. The original idea belonged to Orin Humphries. His efforts involved soldering the elbow to a mount. The solder joint failed readily because of the heat of the exhaust gas. The idea for the integral mount, as shown in the photographs and described in the column, belongs to Stan Johnson. Both Stan and Orin have been using the latest design with much success.

Navy Carrier Advisory Committee. As chairman of the Navy Carrier Advisory Committee, I try to keep members on the committee who can represent the areas in which Carrier events are regularly flown. Ron Haase has represented Florida in the past, but recently he has been inactive in our events and has asked that he be replaced on the committee.

Since I have not flown in the Southeast recently and do not have address information readily available for Carrier modelers in that area, I am taking this opportunity to ask for volunteers. If you are an active Carrier modeler in the Southeastern states and are interested in serving on the Navy Carrier Advisory Committee, please write to me and tell me of your Carrier activities. I will be happy to consider you for possible membership on the committee.

P-38/Stolly

Continued from page 71

structure on the jig throughout the construction process. This not only keeps everything lined up properly, but you can move the jig board out of the way if you want to use your workbench for something else.

I did not build the tail booms aft of former E-11 until the front part of the plane was pretty well completed. This saves bench space and allows easy access to the model while assembly of the innards is under way. It also allows you to work the landing gear and make necessary adjustments with the plane on the jig.

Mark all formers, ribs, and chassis parts with centerlines as shown on the plans. Assemble the cockpit center-pod chassis and formers, making sure that all centerlines match. Assemble the two engine nacelle chassis parts and formers.

Set these three units up about six inches above the jig board, using ⅛-in. plywood supports tack-glued to the board and clamped to the formers. Using a ruler, adjust everything to the proper height by measuring from the top of the jig board to the centerline on the parts.

Wings. Insert and support the ⅛ x ⅜-in. spruce main wing spars, wing ribs (aluminum flap tracks should already be attached to their respective ribs), and the ¼ x ¼-in. wing leading edge. Note that the wing rib centerlines have two degrees of positive incidence in relation to the master aircraft centerline. Starting near the midpoint of the outer wing panels, this positive incidence is reduced to −½°, which is how we build washout into the wing.

Once the wing ribs are lined up where you want them, add the ⅛ x ⅛-in. and 1/16 x 1/16-in. spruce stringers to the top and bottom of the wing ribs. Glue it all up to lock everything in place.

Fowler flaps system. Build in the flap system following the plans and photos, making sure that there is no binding and that each of the four flaps works true and easy. Multistrand .012-in. control line wire was used to connect the flaps to the jackscrew servo. The flaps will go from full up to full down position in seven or eight seconds, which is pretty close to scale operating time.

Landing gears. The parts for the landing gear system detailed on the plans should be machined as accurately as possible, using a drill press for most operations. A jigsaw and a small lathe also come in handy. I removed the limit switches from the landing gear jackscrew servo and relocated them to a spot where they could be easily adjusted to precisely control the up and down limits

of the landing gear travel. The door-closing mechanism is guaranteed to drive you sane and right out of this hobby; but when you see the doors open and close as in the full-size plane you'll be glad you went to the trouble. Be sure to use a balance spring on the main wheels, as shown on the plans, to take most of the load off the jackscrew servo and save wear and tear.

The rest of the project is routine model building, and is covered in detail in the drawings. The tail section is added by again leveling up the centerlines on the engine nacelles, with the centerlines on the tail booms.

For flying the P-38, I modified a J. Roberts three-line handle, as shown in the photo, by adding toggle switches for flap and landing gear control. The center switch selects between either the flap or the landing gear function and also works as an off switch for the whole system. The .021-in. multistrand control lines are braided with enameled copper magnet wire to carry current, because the lines themselves have high resistance and would require 30 or 40 volts to get enough current through to operate the servos. Although the magnet wire itself is insulated, I wiped on a thin coating of clear silicone caulking material to further insulate and bond the wire to the lines.

The main landing gear wheels are fitted with drum brakes which are activated by applying full down elevator while the plane is taxiing.

Locate the plane's ground test box jack at a convenient place of your choice. My box plugs into the starboard supercharger, which neatly hides the six pin plugholes. With the box plugged into the plane, you can operate the landing gear and flaps without having the control lines hooked up. The box also has a switch that activates each glow plug for engine starting. Just throw the switch to the proper engine and hit it with the electric starter. How simple can it be?

Taken as a whole, this is a complicated model that incorporates and reproduces some of the inctricate systems on the full-scale P-38 aircraft. To duplicate the retractable landing gear and Fowler flap systems faithfully is no easy task, but in Scale model building it's the results that count. Not only is this project worth the effort in itself, but it's an exercise in problem solving that may yield insights which can be applied to other modeling problems. That's how the model builder's art advances, step by step. After all, we are routinely doing things in modeling today that would have been difficult-to-impossible just 20 years ago. If some of the features in this model help to move Control Line Scale modeling a notch forward, I for one will be happy.

And when by dint of your skilled and patient efforts you've brought her to life, the P-38 rewards you with a lot of fun in the flying. At eight pounds plus, it's definitely not going to loop for you, but it does fly like a full-scale heavy fighter plane. Feed in the power steadily on takeoff, and after three-quarters of a circle she's built up enough speed to come off the ground with just a slight nudge of up elevator. Hit the gear switch and you can feel her become less nose-heavy as the wheels retract to the rear, and then you're really off and running as the doors close. For landing, throttle back to half power, get the flaps down, and just let it ease on down. As soon as the main gear touches down, the nose lowers, and you've stopped flying—no bounce, no fuss. That's the way it's supposed to be. Keep 'em flying.

Scale documentation for the P-38 is easily obtained from most hobby shops, aviation sections at bookstores, libraries, and other scale documentation sources. My P-38 is modeled after the one on display at the Air Force Museum in Dayton, Ohio.

FF Duration/Murphy

Continued from page 73

you install them. Occasionally you will get a bad one! Good thinking, Eddy!

Well, I'll close the "Aid Station" for now and reopen it again in the next column (which I hope will be only two months from now).

Indoor Rubber Speed. Should we reside in a locale where the winter months all but terminate outdoor flying, then most of our contacts with other Free Flighters will take place at monthly club meetings—and it is here that we must look for activities to hold our modeling interests until