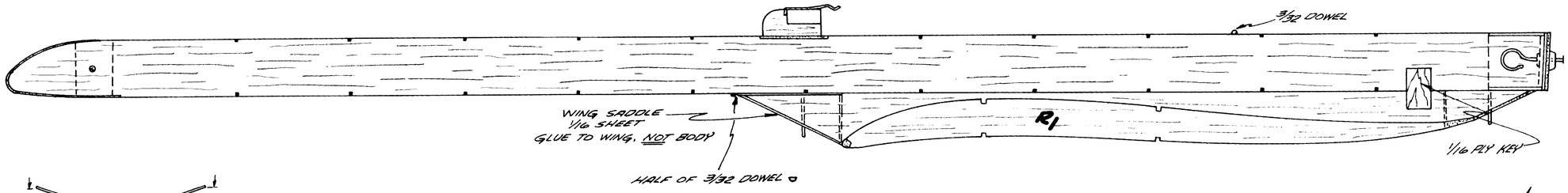

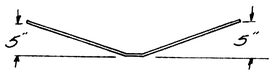

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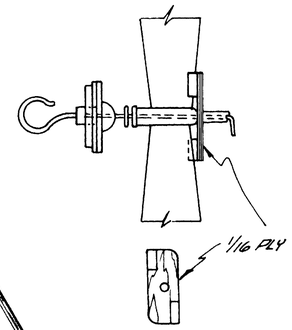

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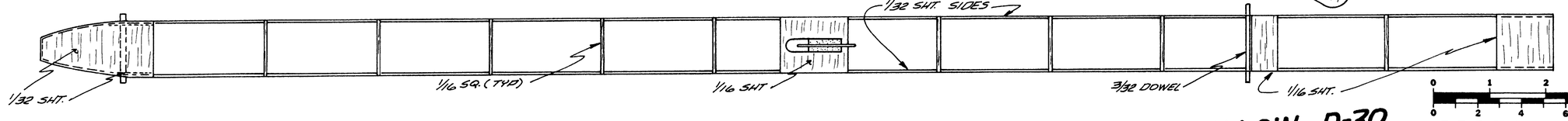
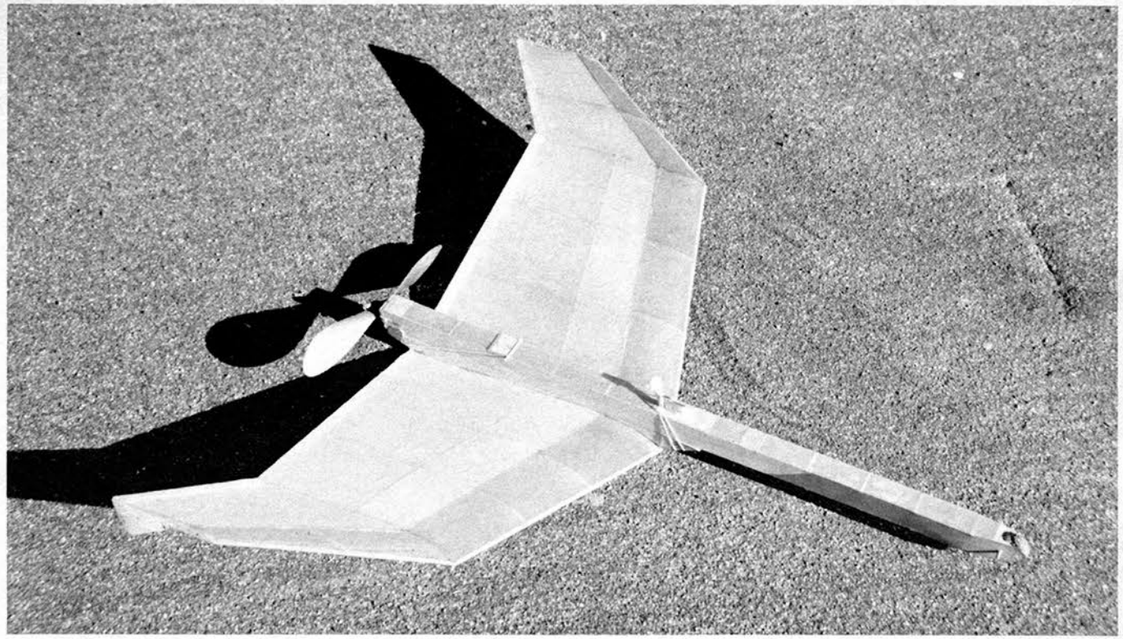


SWALLOW P-30

By BARNABY WAINFAN

MODEL BUILDER magazine
621 West 19th St., Costa Mesa, CA 92627
Plan No: 6872



Swallow P-30

A TAILLESS P-30 RUBBER MODEL

By BARNABY WAINFAN. . .An improved version of the model that won the Open P-30 event at the 1984 Nats, the Swallow is an unusual but effective tailless model. A unique dethermalizer setup helps get it down.

• The Swallow is a tailless P-30 class rubber-powered model which is the latest in a long series of tailless models built and flown by the author. It is a direct evolution of the Cyrano II flying plank which won Open P-30 at the 1984 Reno NATS. The Swallow is a distinct improvement over the Cyrano II in both appearance and performance. It incorporates improvements in planform and airfoil evolved in the past two years, building on the experience gained with the Cyrano. The unusual planform makes it slightly more complicated to build than the constant chord Cyrano, but, due to the lack of tail surfaces, a Swallow will still take less time to build than a conventional P-30 model.

DESIGN

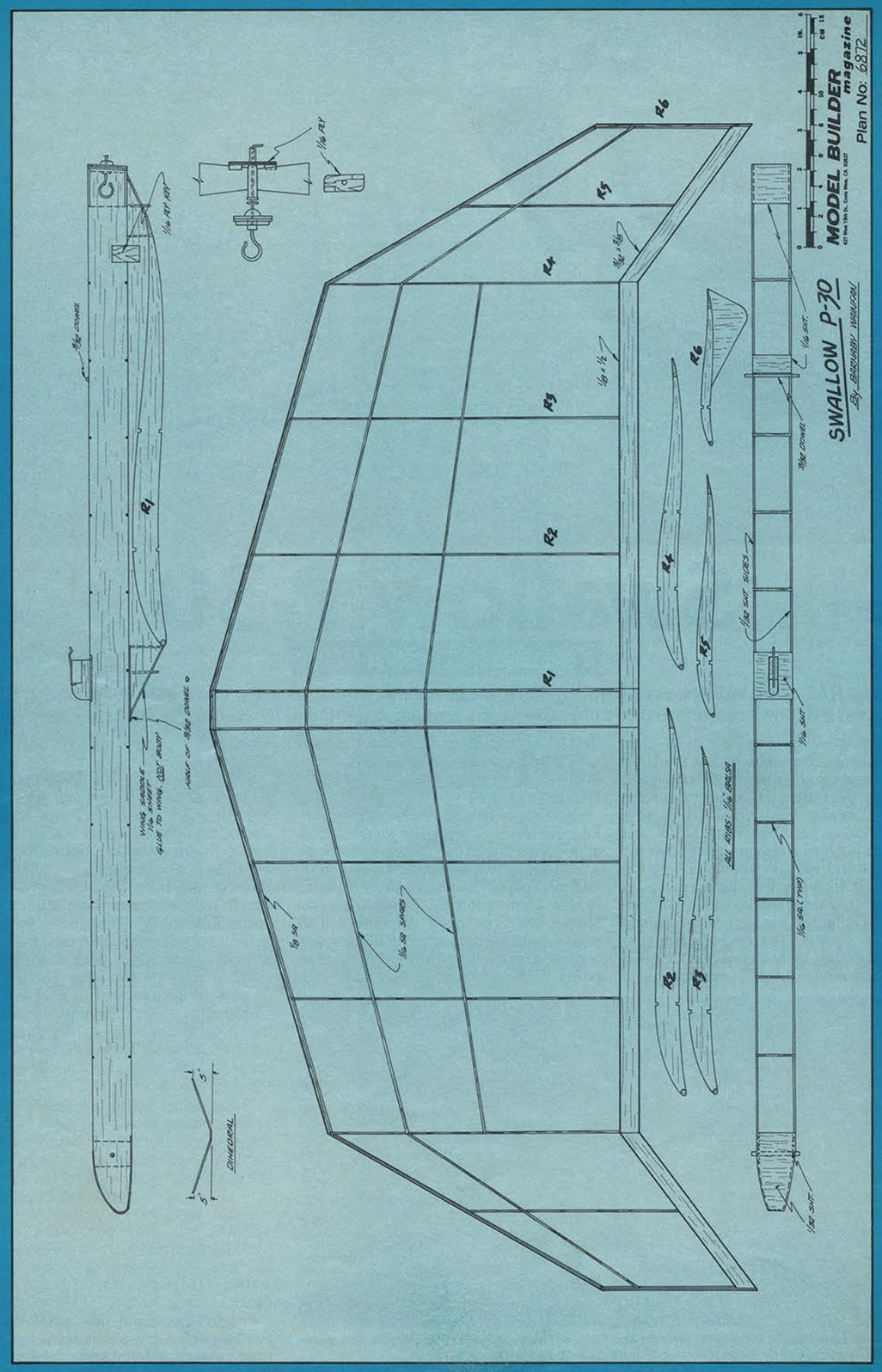
The eye-catching planform of the Swallow's wing was not designed for the sake of appearance only. Its shape was inspired by a Society of Automotive Engineers (SAE) technical paper (SAE Paper #851770) by C. P. van Dam entitled "Swept-Wing Tip Shapes for Low-Speed Airplanes." This paper presented theoretical results suggesting that a wing with a highly swept and tapered tip would have an unusually high span efficiency and hence low induced drag.

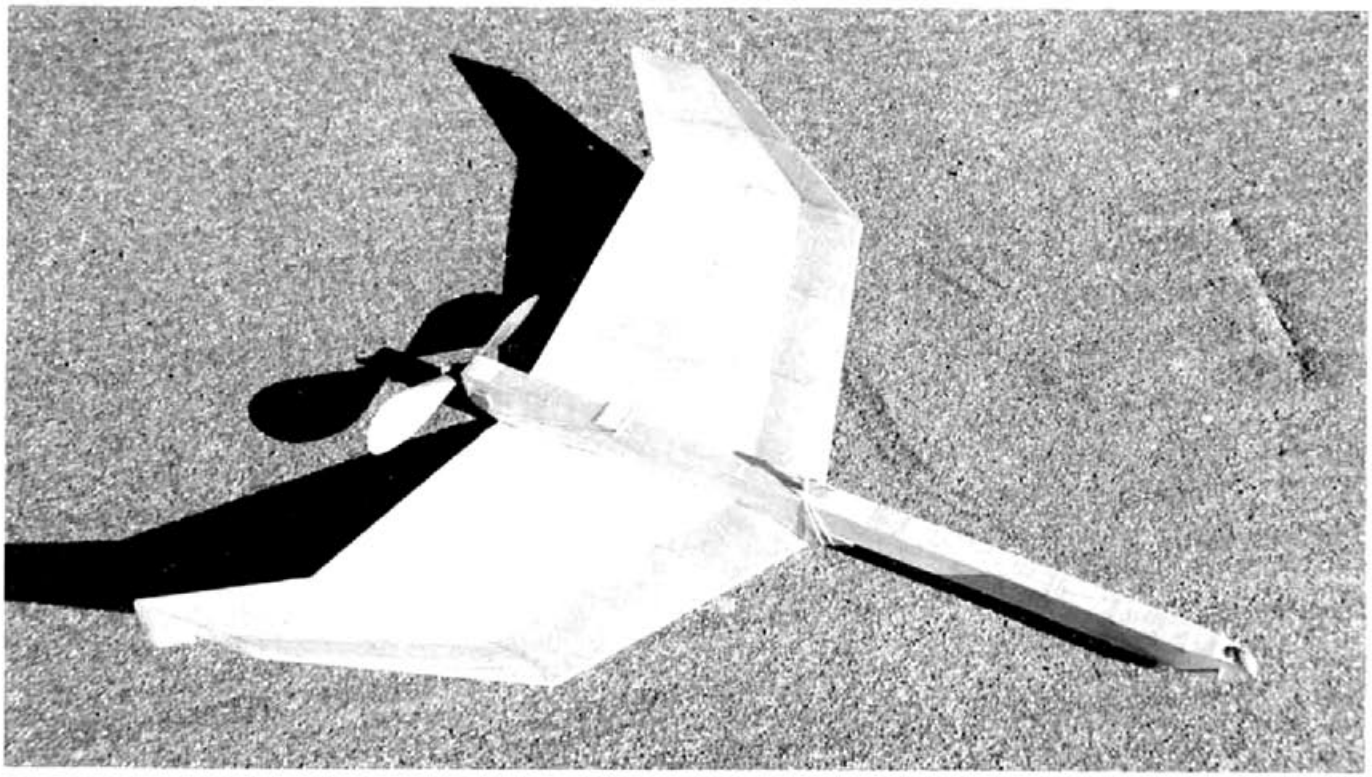
Low induced drag is important for a free flight model since the majority of its drag is induced drag. The normal method of reducing the induced drag of a model is to increase its wingspan and aspect ratio. In a class like P-30 where the span is limited by the rules this is not possible and the only way to reduce induced drag is to increase span efficiency. Winglets are one way to do this, but they add non-lifting area to the wing and increase its parasite drag while decreasing its induced drag. The winglets only pay off if the increase in parasite drag is smaller than the reduction in induced drag they provide. The wing shape suggested by van Dam promised to have the low induced drag of a wingletted wing without the parasite drag penalty.

The optimum leading sweep angle at the tips was found by Mr. van Dam to be 60 degrees, and this is the value used on the wing of the Swallow. The inboard panel of the wing was lightly tapered but left with very little sweep so that the model would retain the easy trimming and good stall characteristics of the pure plank unswept flying wing. This effort was successful. If anything, the Swallow has better stability and stall characteristics than the earlier Cyrano.

In addition to the new planform, the Swallow uses a new airfoil which has more nose camber and a slightly greater maxi-

The author launches his Swallow at Mile Square Park in Fountain Valley, California. The model should be launched with wings level in a slightly nose-up attitude.





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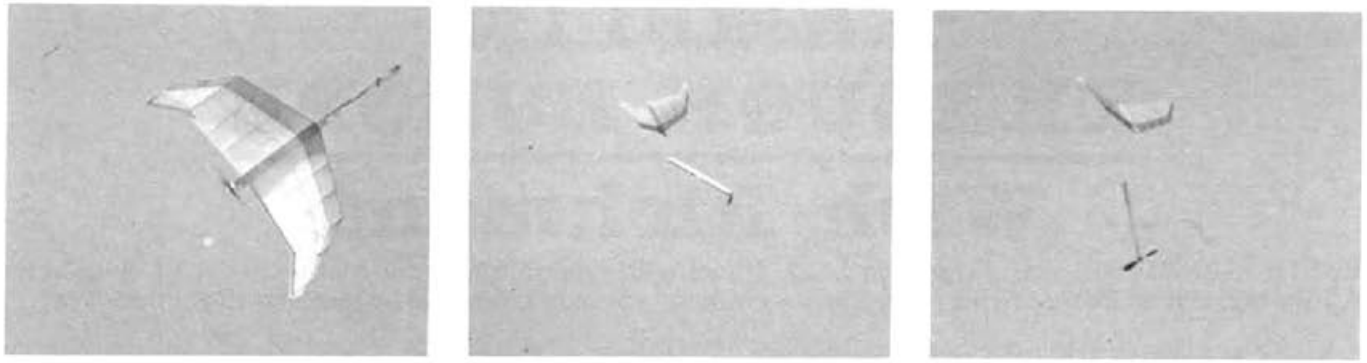
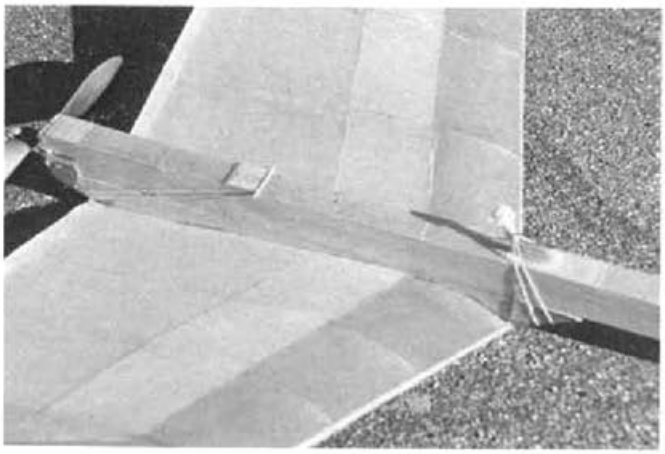
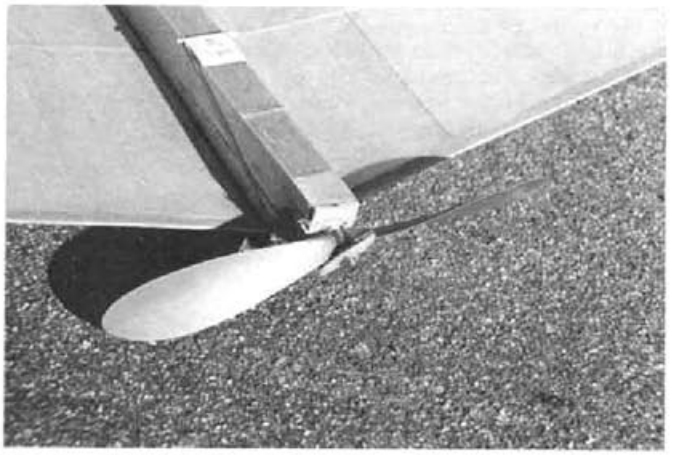


The Swallow in flight, and falling after the DT kicks in. The fuselage hangs from the wing on a monofilament string. In-flight disintegration is the only way to thermalize a low wing-loading model like the Swallow.



The angled rear wing is attached with rubber bands, which assure the wing/fuselage separation when the DT fuse burns through the forward rubber band. The wing keys are 1/16 ply and preserve wing alignment.



Rear view of Swallow shows plywood prop drive unit required to comply with "unmodified propeller" rule. The drive unit fits over the back of the prop, but is not permanently attached to it.

mum camber than the Cyrano airfoil. This new section has higher maximum lift and better stall characteristics than the older airfoil. It is worth noting at this point that the airfoil of the Swallow was specially designed for use on flying wings. The flying qualities of a tailless airplane are highly dependent on the airfoil and changing the airfoil of this model will almost inevitably hurt its performance or stability.

The lack of tail surfaces allows a flying wing to have more wing area for the same total airplane weight since the weight which would have been in the tail can be added to the wing. The Swallow has 256 square inches of wing area, and the prototype model weighed 41 grams. This is only 1 gram over the minimum weight allowed by the P-30 rules. This combination makes the Swallow one of the lowest wing loading models flying in P-30. This low-wing loading really pays off in light lift. The Swallow can climb or hold altitude in thermals which are too weak to support most models. The low wing loading also gives the model a slow, floating glide which maximizes the time it takes to come down from altitude.

One of the biggest problems with tailless models once they are properly trimmed is that the silly things do not want to come down. The lack of tail surfaces makes dethermalizing a flying wing extremely difficult. I have tried many types of spoilers and drag paddles and none have been particularly successful. The prototype Swallow had a drag paddle on the top of the fuselage which opened upward and was supposed to produce drag and a nose up pitching moment to stall the model. During test flights at Taft the drag paddle opened as planned while the model was in a good thermal. The drag paddle had no visible effect on the flight of the model which continued to climb quite happily. The thermal gods were kind, and gave it back to me so I could figure out a better dethermalizing system.

The current system for dethermalizing the Swallow is to separate the wing and fuselage in flight. The fuselage and wing are tied together with a string, and the wing spins down like a maple seed with the fuselage hanging beneath it. This system works very well, but it was not as simple to set up as it would seem. The Swallow is a low-wing model. If the rubber bands holding the wing to the body were simply burned away by the fuse nothing much would happen. The fuselage would sit on the wing and not move much. It was necessary to set up the rubber bands to shoot the fuselage aft off of the wing. This is accomplished by angling the rear rubber bands forward and putting a half round key in front of the wing. When the fuse burns away the front rubber band, the wing rids over the key as the fuselage is shot aft by the rear rubber bands. The rear rubber bands fall away as the wing and fuselage separate. It is well worth the time to check out this system on the ground before flying the model. Hold the model by the wing in a level attitude and either cut the front rubber band with a pair of scissors or use a real fuse. When the front rubber band snaps, the fuselage should move aft at least 3 to 4 inches. Ideally it should be shot bodily off of the wing. This test should be conducted with a motor installed, since this will make the fuselage heavier and harder to move. The system may work fine on the lightweight fuselage and then hang up when the weight of the motor is added. If the fuselage does not move easily when the dethermalizer is activated it may be necessary to either increase the rear rubber band tension or cut away the front of the wing saddle slightly as shown in the plans to make it eas-

The author with his Swallow at Mile Square Park, Fountain Valley, California.

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ier for the wing saddle to ride over the half round key in front of the wing.

CONSTRUCTION

Cut the two fuselage sides out of 1/32-inch sheet balsa. When cutting the notches for the cross pieces, pin the two sides together and cut the notches in both sides at the same time. Assemble the fuselage by pinning one side down to the building board and adding the front and rear pairs of crosspieces. Use a triangle to make sure that these crosspieces are square both laterally and fore and aft. This is quite important since it will determine the straightness of the entire fuselage. The other sheet side of the fuselage is added next, followed by the remaining cross pieces.

After the cross pieces have been installed, unpin the model from the board and add the sheeting at the nose, tail, and dethermalizer fuse mounting point. Do not install the fuse snuffer tube holder or the aft wing mount rubber band dowel until after the fuselage is covered.

Cover the fuselage with lightweight tissue. Make sure to dope the covering to the entire surface of the sheet fuselage sides and to every cross member. This increases the torsional stiffness of the fuselage significantly. Shrink the tissue with rubbing alcohol and when dry dope it with two or three coats of clear dope thinned at least 50%.

When the dope is dry install the dethermalizer fuse holder and rear wing rubber band attach dowel. Do not add the half-round front wing stop yet. It is better to install this stop after the wing and wing saddle are made so that the stop and saddle fit properly.

Note: The wing saddle and fairing are attached to the wing, *not* to the fuselage!

WING

Construction of the wing structure is fairly conventional with one major exception. The trailing edge is standard 1/8 x 1/2-inch trailing edge stock, but it is installed upside down so that the side which forms a 90-degree angle with the front of the stock is on top, not on the bottom like in a conventional model. Study the plans carefully before installing the trailing edge. Make sure that the trailing edge is installed at the angle shown in the plans. The trailing edge angle affects the amount of reflex in the airfoil. Changing the trailing edge angle of a flying wing is very much like changing the tail incidence of a conventional model. The major difference is that you cannot change the trailing edge angle after the wing is covered so it is important to get it right the first time.

Cover the wing with lightweight tissue. Dope the tissue down to all of the ribs and spars. The covering will not accurately follow the reflexed, undercambered airfoil of the Swallow unless it is firmly attached to the ribs. Attaching the tissue to the spars helps increase their resistance to buckling in a hard landing. Shrink the tissue using rubbing alcohol. Using alcohol instead of water gives a gentler, more controlled shrinkage and reduces the chance of warping. Dope the wing with two coats of clear dope thinned at least 50%.

The end plates are made of 1/32-inch sheet. They are added after the wing is covered and doped. The end plates are not absolutely necessary. The model will fly without them, but it will have some tendency to wing rock in turbulence. Adding the small end plates damps out these lateral oscillations.

The wing saddle is made from 1/16 balsa. It is glued to the wing after the wing is covered. The wing keys are added to the sides of the wing saddle after the wing and saddle are glued together. Check the fit of the wing on the fuselage. The keys should keep the wing from moving laterally, but they should not be so tight that the fuselage cannot move aft freely when the dethermalizer is activated.

PROPELLER ASSEMBLY

P-30 rules require that the model have an unmodified commercially available free-wheeling plastic propeller. Unfortunately, the freewheeling notches on all commercially available propellers are on the wrong side for pusher models. The solution to this problem is to make a prop drive as shown in the plans. The prop drive is made of 1/16 plywood, and the tube is either brass or aluminum. The freewheel notch is cut with knife or a razor saw. The tube should be epoxied firmly to the plywood portion of the drive. The drive engages the blades from behind and turns the propeller. In order to comply with the "unmodified prop" rule the drive must not be glued or tied permanently to the prop.

When assembling the tailblock and propeller, remember that the side of the propeller with the freewheel notch goes toward the thrust bearing. The concave side of the blades must face aft for the propeller to thrust efficiently. The details of the propeller assembly are shown in the plans.

TRIMMING AND FLYING

The Swallow is a relatively easy model to trim, but, because it has no tail to adjust, trimming it is different than trimming a conventional model. The model is powered with a single 10-gram loop of 1/4-inch rubber. Be careful to weigh out your motors, particularly if you intend to change motors during competition. Make sure that they are all the same weight. Changing motor weight will change the C.G. of the model, and, because it is tailless, the Swallow is relatively sensitive to changes in C.G.

For initial test flights, set the model up with about 5 degrees of down thrust and no left or right thrust. Start with glide tests. The only adjustment available to trim the glide is the center of gravity. Add clay to the nose if the model stalls, and add clay to the rear of the fuselage if the glide is too nose down. There is no C.G. shown in the plans, since it will be determined during the glide trimming process. Once the glide is set, do not change the C.G. to adjust the power on characteristics of the model.

Start power on flights with low winds and work up. Use thrust line adjustments to control the angle of climb and the power turn. The Swallow flies a left-left pattern. Do not attempt to fly it to the right. Gyroscopic effects on the propeller will cause a right turning flying wing model to spiral.

A small amount of left wing wash in can be used to hold up the left wing under power and to set the glide turn. Adjustments in glide turn can be made with small rudder tabs on the end plates. Do not use aerodynamic turn adjustment to control power on turn. All power pattern adjustments should be made with thrust line.

The Swallow is a cruise climber, using a long, relatively thin motor. It will not bore vertically upward but instead will climb relatively slowly and steadily for a long time. When trimming the climb, resist the urge to trim the nose up excessively. The Swallow has a very distinct backside to its power curve, and it is easy to trim it into a mushing climb at high drag. If the model seems to be hanging in the air in a nose-high attitude, but is not climbing well, add a small amount of downthrust. The model will climb much better if you let it fly up on the wing instead of trying to make it stand on its propeller. •