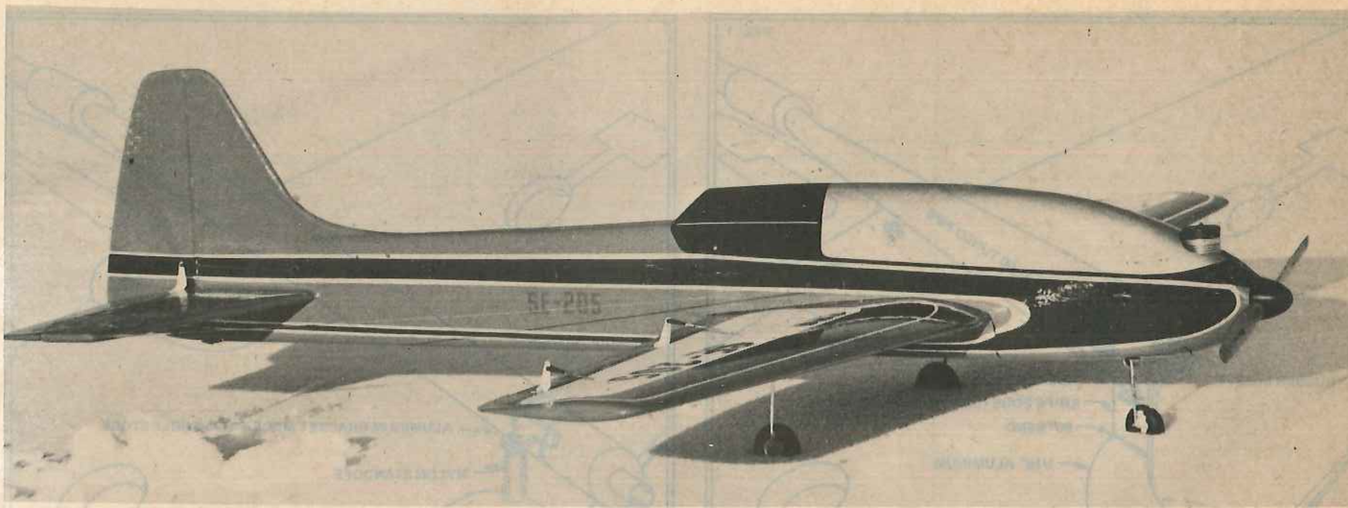

DFH-20

By BENGT LUNDSTROM . . . A top-notch FAI Pattern ship by one of Sweden's best fliers. Designed for .60's with tuned pipes.

• The name means "The Flying Carpenters Bench 20." Years ago someone called my models that. As I am no good at finding names I just kept it, together with a number.

Pattern planes have developed a lot during the last 15 years. We have seen many fads come and go. Many of these fads have had little or no logical background and have disappeared after a few years. You just had to have this or that to be appreciated by one's pals or judges and place well at the contests.

There is one trend that has been there all the time: the more and more powerful engines. You don't win because you have the most powerful engine, but it is always a good help.

When designing the DFH 20, I wanted the most powerful engine to be found, and to put it in a low-drag model with good aerobatic flying capabilities. The easiest way to get a good plane is to make it at least close to a mid-wing layout with reasonable side area. This assures, among other things, good rolls with little or no unwanted reactions when applying rudder in a knife edge position, or applying rudder on top of a Figure M. The DFH 20 has the wing and stabilizer within 3/4 of an inch from the thrust line.

I wanted low drag and equal behavior on "both sides up" in a knife edge. That meant no pipe or muffler in the open or on the side. However, this also means an extremely "good" (which is bad) landing glide. If that is important to you, put in spoilers.

Finally the engine. It had to be one with a rear exhaust to hide the necessary pipe, and a rear intake gives a little more power than the front intake ones. Only the "OPS Speed 60 RCA" qualifies. Nowadays there are some front-intake rear-exhaust engines which would suit the DFH 20 well: OPS .60, Super Tigre X60, and probably the Rossi.

Most hidden pipe designs seen have been rather awkward installations with the pipe under the wing, or a short pipe which works more as an extractor. The DFH 20 design has the upright engine and pipe hidden under a big canopy on top of the fuselage. A lucky thing is that the tank has to be placed low to clear the exhaust tube. This suits the low placed rear carburetor. With a front intake engine, you must use a pressure pump.

The DFH 20 is a very fast plane. As this increases the risk of getting aileron flutter, I use the unusual solution of using double aileron pushrods. These are very safe and also give less drag in full aileron application, as there are no aileron surfaces in the prop wash. They also have more throw in the tip than in the innermost part (twisting ailerons). To take away play, both the rudder and elevator pushrods are doubled, with a little tension in them.

BUILDING THE MODEL

Build it light, particularly in the tail. The high power cannot compensate for too much weight.

THE WING

The chosen airfoil has one very critical feature: the rear third of it is completely flat from root to tip. This makes it very easy to get a straight and warp-free wing, even with this more complicated built-up design. I assure you that you won't notice anything inferior with this airfoil to other more aerodynamically intricate airfoils.

Start by making the wing rib packs, then follow the following sequence:

A) Build each wing half upside down on the rear flat portion. Mount all retract details and center spacers of soft balsa.

B) Fit all sheets to the wing bottom.

C) Remove the wing halves and fit the rear spar.

D) Make the long aileron pushrods and test their fitting.

E) Join the wing halves with the pushrods fitted. Turn the wing right side up now.

F) Complete the upper sheeting.

G) Put the epoxy and fiberglass reinforcement in the center after the wing halves are joined.

H) Mount all retract and aileron servo details now, including the retract pushrods.

STABILIZER AND FIN

Use light balsa!

FUSELAGE

Again, avoid all unnecessary weight in the tail.

A) Make the two vertical sides of equal hardness.

B) Make a subassembly of bulkheads No. 1 and 2 with the hardwood engine bearers.

C) Glue the fuselage sides to the subassembled front and join them in the back. This must be done with a symmetrical curvature. If not, break it up and glue again.

D) Fit the rest of the bulkheads and the stabilizer and fin. Fit all pushrods, tank and retract compartment. Mount the triangular corner longerons.

E) Fit the bottom sheeting.

F) Mount the engine bay blocks.

G) Fit the inclined fuselage sides and the top.

H) Cut out the wing slot and the belly pan. Glue the ply reinforcement above the wing slot.

I) Fit the belly pan to the wing and mount all wing attachment details.

J) Apply epoxy and fiberglass to the fuselage and the wing/belly pan assembly.

K) Make all servo installations.

L) Make the ailerons, elevators, and the rudder. Note that they are a little thinner than the main surfaces to soften up the response a little around neutral (I hope).

MAKING THE CANOPY/ PIPE COVER

A) Make a plug of balsa (or an expanded polyurethane block) which fits the fuselage top front part exactly.

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B) Add balsa downwards to follow the canopy lower outline.

C) Add the 90° mould part line.

D) Using filling compound, make a perfect canopy surface. When satisfied, add a layer of clear polyurethane.

E) Prepare for the female mould by putting a loosening agent and wax on the male model.

F) Make the female mould of polyester (or epoxy) resin and fiberglass for a total completed 1/16 to 1/8-inch thickness.

G) Take out the plug and polish the mould surface.

H) Coat the female mould with a loosening agent and wax.

I) Mold the canopy of 1-2 layers of fiberglass and polyester (or epoxy). Cut around the outline when half set.

J) Take out the molded canopy.

K) Cut the canopy outline, if needed, and make the cylinder hole. Note that this hole ought to be as small as possible. The cooling will be OK anyway. Most of the exhaust tube cooling air *must* come from the bottom intake, which also feeds the carburetor with cool air. If the cylinder hole is too big, too much hot air may enter the carburetor with disastrous results. If in trouble, mount a separating air baffle above the carburetor.

FINISHING

To save weight, use Solarfilm or Monokote instead of paint on the stabilizer and fin. I use cellulose-nitrate paint and a protective coating of clear polyurethane, except around the engine bay and tank, where I use epoxy.

WEIGHT

The weight with empty tank ought to be not more than 8 pounds (3600 grams).

FLIGHT TRIM

A) Check the Center of Gravity position with empty tank and gear down. If necessary, add lead where needed and never move the R/C gear around.

B) Adjust the aileron, elevator, and rudder throw as indicated. I recommend dual sensitivity on rudder and elevator. It is also better to use racks to get a softer reaction around neutral. The disadvantage is that you can't differentiate the throw so easily, but with the newest transmitters you ought to be able to limit the throw individually to each side. If you have an older set, use the rotating outputs with angled connections, if necessary, to get the indicated throw:

Elevators: For normal flying, use as small movements as possible. It is also important to have the same radii for inside and outside loops. The bigger throw is used for spin and snap-rolls.

Ailerons: Three rolls in 5-6 seconds.

Rudder: Normal throw (reduced) for most flying. Full throw for spin, snap-rolls, and figure M.

C) Check the wing tips to make sure they weigh even. If necessary, add lead in one wing tip (it is always necessary). However, in flight you can still have serious problems with uneven-weighing tips. The left and right wing areas are seldom the same. This weight adding can be touchy. Proceed as follows:

Trim the plane straight and level and note if one wing drops. Then fly inverted and note which tip drops. If the same wing drops, this one is too heavy. If the other wing drops, just give some aileron trim.

A much more sensitive method is to apply G-forces by making several outside loops, assuming you first have the plane OK in straight and level flight. If the plane slowly rolls to the right on the top, you have to put lead (0.1-1 oz.) in the left tip. That's because the G-force is adding to gravity in the bottom of the loop, but vice versa in the top.

If you are confused when testing, add 0.2 oz. in one tip and note what happens.

Don't listen to people who say it is impossible to make a warpy model fly OK. It is *always* possible if you work hard trimming it. The warpiness is, however, felt in which side is best for stall, spin, and snap-rolls, but is usually not any big problem; just choose the best side for the snap-roll.

D) The landing gear ought to give a horizontal to slightly nose up attitude of the model. A slight toe-in (2.3°) on the main gear is also an advantage. It reduces the risk of ground loops and makes the retracting a little easier when the main wheels enter the bays.

E) The pipe has to be adjusted to the rpm's you will use. A shorter pipe means a higher rpm, and vice versa. A too-short pipe is more dangerous than a too-long one. A rough estimate says that a 1000 rpm change equals 3/8-1 inch in length.

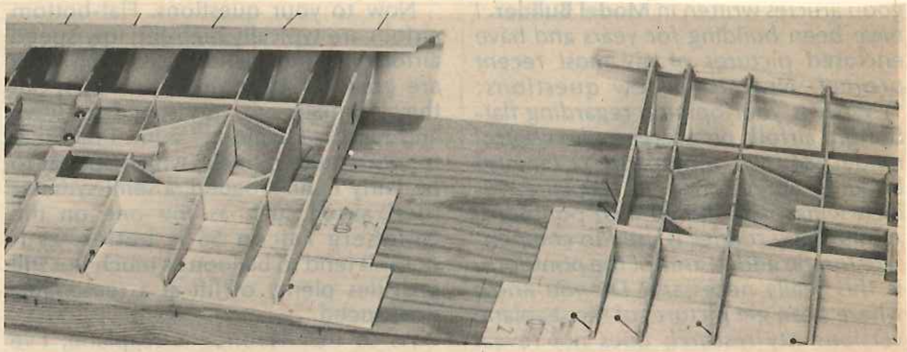
Using a pipe will make the needle setting quite touchy, particularly with a high-power engine like the OPS Speed .60. I strongly recommend an in-flight fuel needle adjustment. Without it, you can find the right setting for an evening's flying, but the next day with another temperature, humidity, fuel, or propeller, it won't work. And you must be "safe" at a contest.

F) Nowadays, noise is more and more an important factor. As this pattern model probably has the most powerful engine to be found, you may have to do some work to reduce the noise. The pipe is usually a very good muffler. No problem here, particularly with the OPS pipe-muffler set-up.

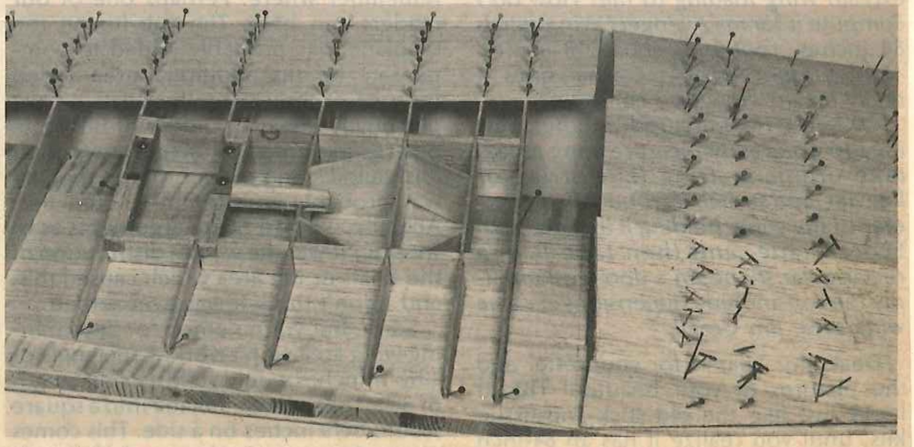
The intake noise is no problem with a rear intake engine. With a front intake, you may need some sort of intake muffler.

The propeller is by far the worst noise generator, and the tip speed is usually the limiting factor. With an 11-inch diameter prop, you can't rev higher than about 13,000 rpm with today's FAI noise standards.

As the OPS .60 needs higher rpm's for full power, you must reduce the diameter. It would be possible to use a 10x8 or 10x9 wide blade prop at 14,000-14,5000 rpm. However, I think a three to four-blade propeller of 9-10 inch diameter, 7-8 inch pitch and wide blades to reach above 15,000 rpm, where the OPS .60 Speed is happiest, would give the best results with acceptable noise. I hope we will be able to buy such propellers soon. I need them! •



Starting to glue the wing sheeting in place. Wings are built upside down.



All of the bottom sheeting is applied before taking the panels up off the board. The panels are built on top of the rear 1/3 of the top wing sheeting, since that portion of the wing ribs is flat.