'70 (and in Fig. 2).

IV. *F/F Rubber Scale Models:* Generally the same as for gas scale. For duration (important in rubber scale), however, these must be able to *climb steeply,* initially, without roll-off and are also discussed in the above article.

OTHER FACTORS

Although the "best" vertical tail size is finally determined only by flight tests, it is helpful to know that other things affect its size, as it will finally be determined, such as:

1. The more the *effective dihedral,* the *larger* the vertical tail will be to prevent "Dutch roll" in real airplanes or models. And effective dihedral includes things other than just the wing dihedral.
2. The *larger* the *prop* and the *more* the number of blades, the larger the vertical tail will be. Rubber models have much larger props than gas.
3. The *faster* the flight *speed,* the larger the vertical tail will be.
4. The *longer* the aft fuselage, or tail length, the *smaller* the vertical tail will be.
5. The *steeper* upward the climb angle, the *smaller* the tail will be.
6. The *location* of the vertical tail will affect its "best" size. The airflow around it is affected by canopies, cabins, by a large horizontal tail, by the prop slipstream speed (prop "blast") and even by the wing position. If mounted directly above or below the horizontal tail, its area will be *smaller* than if located just in front of or behind the horizontal tail.
7. Finally, no vertical tail will be needed if there is sufficient dihedral or cathedral in the horizontal tail. Cathedral is much better for models (for spiral stability). With either of these there is actually some effective vertical tail area present. The amount of effective area is equal to the actual tail area multiplied by the sine squared of the dihedral angle. This is *less* effective area than would be indicated by the sideward, projected area of the tail surfaces.

The interested modeler can refer to other related articles for data and discussions concerning the vertical tail, spiral stability, effective dihedral, etc. These are in the Sept. '68, Oct. '69, Dec. '69 and July '70 issues of M.A.N. magazine.

SUMMARY

1. The vertical tail provides a means of *control* (or trim) for real airplanes and for models. This is done by rudder deflection in real airplanes or R/C, and by incidence settings in F/F models.
2. The *size* of the vertical tail must be large enough to prevent objectionable "Dutch roll" in real airplanes and models. In F/F contest models, it must not be much larger than necessary for this or spiral instability (roll-off) may be a problem.
3. The "best" size for this tail can be determined only by flight tests, by cut-and-try in the field (for a new design). It is cut down to eliminate spiral instability or elarged to eliminate "Dutch roll." ■

FR-1 Fireball

(continued from page 12)

right side up. Drill bellcrank mounting holes in the plywood platform B1 and epoxy in place. The 1/2" sq. hardwood motor mounts are next. Try the following procedure to avoid misalignment problems. Mark and drill the engine mounting holes in each mount. Now bolt the mounts to the engine. Slide the mounts, with the engine attached, through formers F18, 19 and 20. Epoxy firmly in place. When thoroughly dry, remove the engine, and the motor mounts will be in perfect position. Choose your fuel tank and cut out space in formers F3 and F4 to fit. Drill holes in F1 and F2 for fuel line. Install the tank with front end of tank butted up against former F2, using whatever method you like best. I use a 1" wide aluminum strap, slipped over the tank fill-tube, which is bolted through the side of the motor mounts with one 4-40 bolt per side. Be sure to attach generous lengths of fuel-tubing to each tank vent. Attach the lead-out lines to the bellcrank, but do not form the loops in the other ends of the lines at this time. The end loops are formed later after the installation of the wing tip line guides, towards the end of construction. Install bellcrank, elevator pushrod. If you build the model for throttle control, cut an additional hole in formers F1 through F4 for the engine throttle control wire. With all the above gear in place, the remaining four 1/4" sq. bottom stringers, running from F13 to F20, can be glued in place. Upper fuselage formers F2 through F10 are now glued to the crutch, and all the 1/4" sq. stringers installed as shown on the side view. Cement a scrap piece of 1/4" sq. in front of F9 on centerline on crutch as shown in the top view. The horizontal stabilizer platform, H2, is now cemented between formers F8 and F9, resting on top of the 1/4" sq. support. Note that the sides of H2 are beveled to blend in with the fuselage shape.

The blind nuts for the cowl attachment are next installed in formers F2 and F20. Place formers F1 and F21 in position over F2 and F20. The outline of F1 and F21 should lie approximately 1/16" inside the outline of F2 and F20. While holding in position, drill two holes through F1 and F2 and repeat with F21 and F20. The 1/8" holes are shown on the former drawings. Install blind mounting nuts in the holes on the inside of formers F2 and F20.

The fuselage is now covered with 1/16" sheet balsa. When completed, the jet nozzle, former F11, can be added.

Cowl: The cowl is built in two separate units. Assemble the bottom cowl first by pinning F1 and the semicircular balsa ring, C1, upright on the top view with their straight edges down. Install the three 1/4" sq. stringers between them. When dry, cover the curved surface with 1/8" sheet balsa. This can be done with two panels of sheet, each one extending from the center stringer down to the side stringer. Cut the panels oversize, soak in hot water, pin to the cowl and let dry. When dry, the panels will retain their curvature. Glue the panels in place. When dry, trim off any excess so the skin is flush with F1 and C1. The front of the cowl is made from two semi-circular rings of 1/2" balsa, glued to C1. The cowl front is then shaped as shown in the top and side views. The above procedure is then repeated in making the top half of the cowl. Cut-outs in the top cowl can now be made for the engine cylinder head, exhaust port and needle valve access. Mix up some epoxy and coat the entire inside of the cowl for fuel-proofing.

Horizontal Stab: Cut out the 3/16" horizontal stab, H1, from one piece of 4" wide sheet. Note that the horizontal has a stab cut-out similar to the crutch for the tab of the vertical stab to pass through. Cut out elevators and join together with 3/32" wire. Hinge elevators to the horizontal stab. Horizontal stab is now glued to platform H2, making sure that the cut-outs for the vertical stab tab line up.

Vertical Stab: Cut out vertical stab, V1 and V2, and cement together. Once again, V1 has a tab which extends down through the horizontal stab and the crutch. Glue the assembly in place. V1 rests on top of the horizontal stab, while V2 rests upon the platform H2. The assembly has no offset, and should line up with the centerline of the fuselage. Cut out the dorsal fin, V3, and cement in place. V4 is then installed after making a small cut-off to clear the elevator joiner wire so that the elevator motion is not restricted. The rudder, V5, is installed next and is offset 1/2" to the outside of the flying circle. Scrap balsa is then used to make a fillet at the base of V2 to fill in the fuselage outline