A Precision Contest Gas Job

How You Can Construct a Small Realistic Gas Model That Has a Comparatively Slow Speed But High Consistent Performance

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Part No. 1

AS GENERALLY acknowledged, the Precision-Type Gas Model Contest is fast becoming standard, with purely durational meets now practically a thing of the past. Any conscientious builder, upon entering this more scientific type of competition, is immediately impressed with the new phases of judging his model, with engineering, construction and workmanship sharing with points awarded through actual flight of the plane. The writer is pleased, therefore, to offer the gas model enthusiast this ship, of original design, which will ably meet every requirement for this type of contest. The generally used point system in the precision contest is as follows:

A. Engineering (20 points-Maximum)
   1. Design
   2. Construction
   3. Workmanship

B. Take Off (20 points-Maximum)
   1. Take off
   2. Duration
   3. Approximate distance

C. Flight (25 points-Maximum)
   1. Stability
   2. Performance

D. Landing (35 points-Maximum)
   1. Approach
   2. Attitude as to landing position relative to restricted landing area of field

Total possible points-100

It should now be quite evident to any builder, heretofore unaccustomed to the precision meet, that the many "breaks" usually obtained by the favored few in strictly durational meets are cut to a minimum. Another phase of duration contests, that of the stubborn element of gas jobs flying out of sight and becoming lost, is entirely eliminated. The most important feature is the way in which this kind of competition literally "forces" design and workmanship advancement out of gas model builders, a fine feature which durational meets cannot generally claim.
Most precision meets allow two official flights, each being the usual limit of 45 seconds, or less, of the engine operation. As will be noted, this ship is equipped with a very efficient flight timer for this purpose.

Before going further, the writer would like to take this opportunity of expressing his complete satisfaction as a result of employing the X.G. aerofoil in this design, developed by Mr. Charles H. Grant and previously proven so successfully on the famous KG gas job. This has primarily kept the speed down to a conservative rate for this size model and engine power (5 ft. wing span - 1/6 hp. engine.) It also offers a steep angle of climb which is most important in flying this model in the precision - type contest, provided it stays over the field through proper circling adjustment. The glide is also benefited to a great extent by this wing section. Other design factors advocated by Mr. Grant have been incorporated in this design, all contributing greatly to the flight ability of the plane.

This gas model uses the Bunch Engine, although similar engines of 1/6 to 1/5 hp. can be used, provided the motor mounting plates and cowling holes are re-styled slightly. The wheels used on the original are Ohlsson Streamlines, but any of similar diameter (3-1/2 inch) will be satisfactory. Take ample time to build all units as construction and final finish are important factors.

One last word before the actual beginning of the construction. In installing all metal fittings used in the ship, that is, where each is to be cemented to balsa, use only metallic cement such as is on the market, but which can be easily prepared by any model builder. The writer employs it in connection with all metal fittings in all of his gas jobs, and the great strength resulting through its use makes its preparation very worthwhile. It is generally believed that a metallic cement is the result of painstaking chemical research. Possibly some of that on the market is, but anyone mixing aluminum powder (not too fine) with a good grade of model cement to correct consistency has a metallic cement equal in strength to any fancy preparations offered in stores at a fraction of the cost. Of course, use the customary clear cement in all balsa-to-balsa joints.

**Fuselage and Landing Gear**

To begin construction of the fuselage, first lay out the fuselage frame (side and top views) on paper, full size, enlarging from the assembly drawing (Plate 1) through use of the scale. Be sure to retain the long gradual curve in the rear section of the fuselage frame. When the frame has been drawn to actual size, select some 1/4" sq. hard balsa for the four longerons. All vertical and diagonal bracing is 3/16" sq. hard balsa. Be certain that stock for the vital members is of the best. Now build the side frames. Use 3/16" sheet balsa of widths specified in forming the cabin windows. Notice that the top longerons in the fuselage frame stop at the point where the front wing panel fittings are installed.

Auxiliary 1/8" sq. longerons of comparatively short length are built in to form the bottom line of the cabin windows and which extend to the front ends of the side frames. As the curve of the fuselage frames is somewhat abrupt on the bottom side at the nose, take care in forming this section. Now cut two 1/8" medium sheet balsa panels, to be installed in each frame at the rear end for ample protection and strength where tail surfaces are attached. This will complete the side frames of the fuselage, and now it is possible to build the two frames together as shown in the top view. Again, in completing the bending operation at the nose, caution should be used, and it is probable that the 1/4" sq. longerons at this point will have to be steamed to obtain the correct curve.

Now that the bare fuselage is completed, including all diagonal bracing, install diagonal bracing internally at each vertical member station, from the rear of the cabin to the start of the solid balsa panels in rear end. This insures a very rigid fuselage. Be sure to install them from one corner to another in alternate fashion. Avoid having the whole series of these internal 3/16" sq. balsa braces running in the same direction. Put in the rear motor beam anchorage bulkhead, which is shown on Plate 3. Carve the solid balsa section (over the windshield) from medium balsa: Install it, with a section removed from lower rear corner, against the ends of the upper longerons and the cross brace which has been previously cemented at this point. Permanent rigid bracing of the balsa block will be possible only after the 1/16" alum. tubing braces have been installed, when the nose formers are in place. The dotted lines around the edge of cabin windows and windshield indicate the single pieces or celluloid which are installed later, flush with fuselage surface, so that when fuselage is covered, they are perfectly flush with the surface.

In installing the wing panel fittings in fuselage, run 3/32" O.D. alum. tubing across fuselage, leaving ends projecting slightly on each side, so they may be spread with a center punch after passing through the square aluminum pieces which are cemented in position flush with the fuselage sides. Use cement freely in this installation. The tail post of the fuselage should now be cut to correct shape and installed, after first drilling three, holes through it to obtain negative adjustment on the stabilizer. (This model should not require any positive setting, but if such is needed, the
holes in the front metal fittings on stabilizer can be elongated with a file.) The aluminum plates which are installed on each side of the tail post are cemented in position flush, matching the holes drilled through the balsa. The aluminum tubing going through the fuselage for the stabilizer pins is 1/8" O.D. Each length is riveted over the small aluminum plates in the same manner as the wing panel fittings in the forward end of the fuselage. Before the sheet balsa filler on top of fuselage is cemented in place (section under fin) cut out and install an internal piece of 1/8" sheet stock also, which supports the lower ends of the 3/8" O.D. aluminum tubing into which the fin pins slide. Drill it with two 3/8" holes first, in proper positions. Now the top filler can be installed permanently, after first drilling it for the tubing. Cut two sections of the 3/8" O.D. aluminum tubing and install them, cementing securely at each joint with the balsa.

Before proceeding with building up the nose, the landing gear must be installed. Be sure that the 1/4" x 1/2" cross braces under fuselage frame, upon which the wire members of the landing gear are mounted, are installed very securely, and it is suggested that pins be run in for additional strength. Install the corner braces cut from sheet balsa, only after the wire has been installed on cross beams and securely bound with very heavy thread. Use the metallic cement here very generously; if it is done correctly, there is no reason for it to ever jar loose. The landing gear itself consists of three 1/8" piano wire frames, formed first to the correct spread and length. The front, side landing gear wire is the one which forms the axles. After installing on cross beams, connect the two side frames and the center shock - absorbing member together at the bottom, using small copper wire to bind the two joints together. Solder these well, allowing the flow of solder to form a good union. The balsa landing gear ribs will be presented in the second installment, as it is not necessary to put them in just yet.

Cut out the nose formers and install them at the correct locations. At this time the formers used on the removable hatch on top of fuselage should also be cut and installed. Now procure some hard balsa stringer stock, size 1/16" x 1/8". The nose has quite a number of stringers, but these enhance the appearance greatly in this vicinity. As will be observed by looking at the assembly drawing, the completed stringer installation blends from a perfect circle at firewall out to almost square form at their termination point.

The firewall should now be made. It is shown full size on Plate 2 and is circular in form, being the same diameter as the engine cowl, 4-3/4". It should be formed from medium hard balsa having a thickness of 3/4". The rectangular motor beam holes are cut out by drilling with a 3/16" drill in the sections to be removed and using a coarse file or sandpaper on narrow block to procure the correct size and shape holes. Prepare the other necessary holes and the three studs upon which the cowl support rods are hung. Use 4-36 brass machine screws for these studs and get the correct length by cutting them off if necessary. Each should project 1/4" after sinking and cementing flush, from the rear side of the firewall. See assembly drawing for correct curving on edge of firewall. Cut four 3/16" aluminum tubing spacers and cement to firewall, near edge, as shown. The firewall may now be cemented to nose former N-1. Use an ample quantity of cement in attaching it securely. Now that the nose stringer installation is completed, the 1/16" aluminum tubing bracing can be installed between the top section of former N-3 and the solid balsa block over windshield.

In making the engine mounting beams, use high grade wood only, as a lot depends on this material. The writer feels that hardwood beams are far superior to a metal motor mounting, from personal observation. A metal mounting can only bend and collapse while the hardwood beam type absorbs all sudden shocks to which it may be subjected, provided it has the required "spring" in it. Black walnut makes an ideal mounting material, having the required "spring" and being a tough, hard-to-split wood. Maple also is excellent. Cut two pieces, size 3/16" x 15/16" x 7-3/4". In installing them, use metallic cement and make sure that all joints are very solid. Drill all holes necessary for metal mounting plates before installing the wooden beams in fuselage.

Use 1/16" sheet balsa for making the cabin floor and the vertical bulkhead which is installed at the rear end of the cabin. It is not necessary to cover the sides of the cabin interior unless desired. The motor mount bulkhead MM forms the enclosure for the front end of the cabin.

The stringers on the main part of the fuselage should now be made. They are cut from 1/16" sheet balsa and must have a curve as shown on assembly drawing. The top of the fuselage has five stringers, while the sides and bottom have three, respectively. The top stringer on each side of the fuselage is terminated where the tail surfaces begin, when in place, as shown. Soft balsa is sufficient for this fairing work. Now that the fuselage is practically completed, the removable hatch over the cabin should be constructed. Formers F-1 and F-2 are at each end, and 1/8" sq. balsa bracing is installed diagonally. Dress snaps are installed with cement flush with the surfaces. The switch and booster socket panel, as described on Plate 3, is installed where indicated on
drawing. Any electrical supply or department store can supply a small "button" switch. It will be necessary to paint two sections on opposite sides of the revolving button, to show when switch is on or off. This switch is obtainable at a nominal price and is small in size, insuring a neat switch installation. So many gas jobs are spoiled by using a cumbersome, large toggle or throw switch, when a "button" type could be used just as readily. The wiring of the ship and the battery box detail will be discussed in the next installment.

The flight timer and timer switch installation should prove self-explanatory. See Plates 1 and 2 for this detail. This timer is obtainable from the same concern which manufactures the engine used in this model.

The tail wheel unit is a simple fork of 1/16" piano wire which pivots on a piano wire cross-arm, installed across the two lower longerons at the point shown. A spring is now fastened to the tail wheel fork and secured a little to the rear, in the fuselage, at the other end. Be sure spring is of right type. It should be fairly stiff in action.

The cabin windows are put in later. The original model has its cabin painted with a dark color dope to remove the "raw wood" appearance. It improves any gas job greatly and may be done at this time.

The fuselage should now be practically complete and should be lightly sandpapered to remove any drops of excess cement, etc., so it will be smooth when covered. All marks left by a circular saw where balsa has been stripped should be sanded out.

Next month the engine cowl, tail surfaces, wing panels and remaining details will be described.
**CS**

**20 GAUGE ALUMINUM RING**
( Rear Support of Cowl)

**GROUND WIRE HOLE**

**ENG. MOUNTING PLATE**

**BEND HERE**

**ENGINE MOUNTING PLATE**

**GALVANIZED SHEET METAL 24 GA.**

**MOUNTING SCREW HOLE**

**NOTE: LOCATION OF HOLES IN MOUNTING PLATES FOR ENGINE & TANK WILL VARY SLIGHTLY WITH EACH ENGINE**

**FIREWALL**

**3/16" O.D. WASHER**

**4-36 BRASS MACHINE SCREWS-HEADS SUNK IN REAR & CEMENTED**

**ENGINE MOUNTING BEAM HOLES**

**ENGINE MOUNTING BEAM 3/4" THICK ~ MEDIUM Balsa**

**SPARK PLUG WIRE HOLE**

**3/16" ALUM. TUBING SPACER**

**3" HOLES FOR AIR PASSAGE THROUGH COWL**

**1/16" RD. HEAD WOOD SCREWS USED FOR HOLDING RING IN POSITION**

**WING STRUT FITTING DETAIL**

**GALVANIZED SHEET METAL RIB ~ 24 GAUGE**

**1/16" O.D. BRASS TUBING SOLDERED TO RIB Balsa Rib Backing**

**#31 DRILL 3/16"**
IN THIS second and concluding part, drawing Plates 4, 5, and 6 are included, covering the parts for completion of the plane.

The landing gear ribs are cut out and installed in the landing gear "V's" as shown on Plate 1. These are found on Plate 6. Make sure that all are secure. Corner braces between the ribs and wire may be put in for added cementing area. Cut two ribs from No. 24 galvanized sheet metal and solder well to the piano wire in the correct position. It will be noted that all landing gear ribs are put in parallel to the fuselage, the first one next to fuselage being the only exception. (L-1 follows fuselage longeron.) See Plate 2 for the wing strut fitting detail at the landing gear. Cut four
lengths as shown of 1/8" O. D. brass tubing. These are soldered in the positions indicated. A side of each section of tubing should be flattened slightly with a file to insure ease of handling in soldering to the metal ribs.

The battery box, coil and condenser mountings are installed in the fuselage at this point, preparatory to wiring. See Plate 6 for perspective view of battery box. After completing, cement it securely to the cabin floor and also against the 1/16" sheet balsa bulkhead. The coil mounting pieces are made from 1/8" sheet balsa and fit directly against the forward side of the battery box. The condenser mounting brackets are also cut from 1/8" sheet stock and cemented to the cabin floor. Use metallic cement in connection with the installation of the coil and condenser in their respective cradles.

Study the wiring diagram on Plate 1 before beginning the job. Use stranded flexible copper wire, insulated covering of course, in all wiring, with the exception of that between the motor-mount bulkhead MM and the engine, which should be of heavier variety, similar to type used for automobile spark plug wiring, as these three wires (ground, timer and spark plug) are exposed to the gas, oil, etc., which will form to the rear of any engine to some extent after engine has been running. The plug cable should be well insulated by all means.

May the writer point out that the booster batteries in this wiring system are right in on the main line with the flying batteries, which works the best of any method, inasmuch as the booster lines need only be pulled out after motor is running, the flying batteries carrying on in an uninterrupted circuit. To use a booster battery with this system, one merely inserts the booster plugs and turns ON the switch and the engine is ready to begin operation. When the main switch is turned OFF and booster leads are still inserted in plugs, the current from booster also terminates with that of the flying batteries in the fuselage.

Engine Cowl and Exhaust Manifold

In building the cowl, extreme care must be taken in all operations. This unit will give any gas model builder good practical experience in metal working. The N.A.C.A. type cowl, as used with this ship, will allow better cooling of the engine than the "in-line" type cowling, and it contributes greatly toward the final appearance of the model, giving it a real plane appearance, even to the side panels, which can be raised for inspection, fueling, etc., similar to the N.A.C.A. cowl on the latest Fairchild cabin plane.

The primary step in the cowl construction is to get the front ring made. This is "spun" on a lathe and due to the easy curve, anyone having access to a lathe can easily make it himself with a little care. If one is not in a position to make it, any metal-working concern in his vicinity which does metal spinning will make it, including the hardwood form, for a very nominal sum.

However, if one plans its forming, the first thing to do is to make a hardwood form, turned on a lathe. This should be finished to 4-3/4" diameter, minus double the thickness of the 20-gauge aluminum forming the ring. In other words, allow for the thickness of the metal in turning the wooden form so that the aluminum ring itself will be 4-3/4" diameter when completed.

Secure a sheet of very soft (grade used for spinning) 20-gauge aluminum and secure with four screws against the front face of the form. Leave the sheet amply large for completing the ring to the rear edge, but don't leave too much excess, as it will be bothersome in the spinning operation. Begin to work it around the curve very gradually, using a hardwood stick (about 1" x 1") with corners all rounded off and smooth. The stick must be long enough to reach under one arm so that sufficient leverage and pressure can be obtained with it. The lathe should be operating as fast as possible. After the metal has been completely worked around to the rear face of the wooden form, use a cut-off tool to remove the excess metal and to form the rear edge of the ring. The next step is to polish the ring to a plating finish, which is followed by the use of a narrow lathe tool in cutting through the metal on the front face to obtain the desired size opening (3-1/4" diameter.) The ring will then fall free from the form. Remove a section of a 1-7/16" circle as shown on cowl detail, Plate 4. This is of course the opening through which the cylinder passes. The holes required on the front face of the ring should be drilled next. The three large holes are 120 degrees apart.

The landing upon which the side panels rest, at their front edge, is riveted in place around the cowl ring as indicated on Plate 4. This discontinues at the cylinder hole. When done correctly, a 1/8" strip will remain for the side panels. Use small aluminum rivets, 1/8" long with 1/8" flat heads, in all small riveting done on the cowling. The spacing of them for fastening the strip just described is clearly shown on the front view of cowl. The center top section of the cowling is made and installed next. It is 20-gauge aluminum (soft.) First cut out the remaining section of the cylinder hole to match that in the ring. Prepare the hinge notches and holes, also the needle-valve and spark-plug wire holes. When all holes are completed, bend the piece to the proper curve required, considering that it is a 2" section of a 4-3/4" circle. The two small brackets
which secure the rear end of the top section to the rear cowl support ring are now riveted in place (one rivet each.) The hinges (which are purchased at any large hardware store) are to be riveted on this center section also, before riveting it to the spun ring. Cut the bracer C-1 and cement it in place with metallic cement.

Proceed to rivet the top center section to the cowl ring (actually the riveted strip.) Obtain some sheet aluminum stock, half hard preferably and 24-gauge, for the two side panels. The hardened variety is preferable so that the side pieces will be springy after being rolled to shape. Cut two pieces, size each 3-3/4" x 6-7/16", and remove the section through which the exhaust manifold passes. Drill and install the pair of fasteners on bottom ends of the two pieces. Also file the hinge slots and drill the hinge holes. When all of these operations are completed, take the panels to a sheet metal or tin shop and get them rolled in a rolling machine. Take along a tin can or other object which is about the cowl diameter to use in getting the panels to the exact size curve to conform with the 4-3/4" cowl diameter. Before going further, make the three cowl support rods from 3/16" O.D. aluminum tubing, as shown on Plate 4. Rivet the two upper ones permanently in the two upper holes in cowl ring. (The lower one is removable so cowlring may be removed with motor and tank in place.)

Now rivet the two side panels to the hinges. Trim each one slightly at this point so fasteners snap tightly, with each side panel just meeting and no more. Two 3/16" O.D. aluminum tubing brace rods are made to be used with the cowl. These extend from the two small holes, next to bottom cowl support-rod hole in front ring, to the first engine mounting screwhole in each engine mounting plate. Flatten the tubing and drill holes in the ends similar to the main cowl supportrods.

The metal ring supporting the cowlring at the rear and the engine mounting plates (mounted on the hardwood beams) are shown on Plate 2.

Cut the ring from 20-gauge soft aluminum and punch holes, size 3/8", around the ring for passage of air. These can be drilled if no punch is available. Drill the four mounting screw-holes and also the two holes at the top to which the small brackets on the top section of cowl are attached. Mount the ring on the previously prepared aluminum tubing spacers with 5/8" round head wood screws.

The two engine mounting plates are of 24-gauge galvanized sheet metal. Drill the holes to match those previously drilled in the hardwood beams. The holes for the engine and tank mounting screws should be put in at the same time. (Check your own engine and tank holes for spacing against those on mounting plate illustration.) Bend each plate at right angle where indicated. Mount each one on the wooden beams with 6-32 machine screws (use dural screws and nuts if possible.)

The exhaust manifold, illustrated on Plate 4, is constructed of sheet tin (coffee can, etc.) over a balsa form. The seam is a simple lap joint, brazed. The exhaust manifold should fit tightly between the bottom cylinder fin and the intake jacket. File two brass pieces to the shapes shown and have them brazed to the sheet tin butt-joints. A little care must be taken in all brazing done on this unit as the tin is rather thin and a brazing torch can easily and quickly burn a hole in it if caution is not used. File the manifold smooth with rounded corners. Drill holes to accommodate 4-36 screws in the solid brass pieces as shown. The strap for holding the exhaust manifold in place is a 20-gauge strip of aluminum. It is suggested that the completed manifold be dull nickel plated. This "hides" all brazing and gives a one-piece appearance.

An extension will have to be made on the engine needle valve so it may be operated through the cowl. This can be merely a brass screw soldered firmly on the head of the standard valve. Regarding the timer advancement with cowl in place. The writer has always been able to start his engine with the timer in fully advanced position, bringing the engine up to proper r.p.m. through carburetor adjustment only (needle valve.) However, this may not be the case with all power plants. If a timer extension through the cowl is necessary, it is suggested that a slot be cut in the cowl ring to operate an extension lever on the timer.

Tail Surfaces

Both the fin and stabilizer are of identical construction. See assembly drawing (Plate 1) for detail on empennage members.

Cut out the leading and trailing edges, tips and designated ribs from 1/16" sheet balsa of firm variety. All diagonal bracing is of 1/8" sq. balsa. The fin and stabilizer spars should be of very hard stock, especially the stabilizer spar. The dowel pins in fin are of hardwood and should be of such diameter (5/16" approximately) as to fit tightly in the aluminum tubing in the fuselage. The fin tab for torque adjustment is fastened in place with copper or brass wire hinges.

Cover the leading edge of both the stabilizer and fin with 1/32" medium sheet balsa. It is advisable to wet the sheet where it takes the abrupt bend on the actual leading edge of each tail member. The stabilizer fittings for securing it in place on the fuselage are clearly shown on Plate 5.

Wing Panels and Wing Struts
Select very hard, good quality, 1/8" sheet balsa for the wing spars. All other balsa in wings should be medium hard. Due to the up-curve on the wing tips (excellent insofar as lateral stability is concerned) and also the tapering of the wing panels at the fuselage end, the wing spars are rather irregular, being curved for these purposes. After cutting them from sheet stock, begin the cutting of the ribs, leading and trailing edges, and wing tips. To build a wing panel, first slide all ribs over the spars in their approximate positions. Now pin the spars in place over the full-size wing panel drawing. The ribs are now put in position and cemented. The trailing edge (1/8" x 3/8" balsa, tapered in cross-section) is laid down and cemented in place. The wing stubs at fuselage are carved from solid balsa blocks, as shown on assembly drawing, and are securely attached to wing ribs W-1. The wing strut fitting for the wings is shown full-size on Plate 3. The fittings for the wing panel pins, which are very securely attached to the stubs, as indicated are, like the wing strut fittings, formed from 20-gauge sheet aluminum. A hole, which 1/8" O.D. aluminum tubing will just pass through, is drilled through these wing stub fittings and the balsa stub after fittings have been cemented in place. The tubing is spread on each end and hammered over to form a strong rivet, as was done on the fuselage for the stabilizer pins, etc. Each wing panel is covered with 1/32" sheet balsa on the front section, the same as was done on the tail surfaces. Due to the curve at the ends of each wing panel, it will be found necessary to piece the veneer to a certain extent. The diagonal bracing is 1/8" x 1/4" balsa and gussets are added to the trailing edge at each rib for additional strength.

The wing struts are rather unusual in design. Each is formed from 1/2" sheet balsa stock, which should be medium hard. See assembly drawing for detail on this part. Carve and sand each one to the aerofoil shown on Plate 6. The fitting which slides in between the brass tubes on the landing gear is shown on Plate 4. This is riveted to the struts using 1/8" O.D. aluminum tubing in the same manner as the wing stub fittings. The metal fitting at the small end of the strut is shown on Plate 5. It is also riveted, as well as cemented, in same fashion as the fitting at the base of the strut, but 1/16" O.D. aluminum tubing is sufficient in this application.

Now we shall return to the fuselage for the installation of the windshield and side cabin windows. See Plate 6 for the windshield template. Get good sheet celluloid, preferably .015 thickness, for this work. Be sure it has no prominent scratches on the surface. Using the template, cut the windshield out and install it, using cement carefully so as not to smear the celluloid. Use pins until cement is dry. The side pieces of celluloid are cemented in next and each should be perfectly flush with the balsa surface of the fuselage sides, done by removing balsa around window frames the thickness of the celluloid (see assembly drawing for dotted lines showing this.)

On the original model the writer conceived the idea of shellacking the entire nose construction of the fuselage, from the firewall back to the windshield. This has proved to be most successful in the prevention of gas and oil softening cement joints in this vicinity. Engine fuel will eventually get to most parts of the nose on most any gas job, and by shellacking, no breakdown of cement at joints can possibly result from such a condition. So it is suggested that this be done at this time, just prior to covering the plane.

Covering and Finishing

The writer's model was covered with a good grade of bamboo paper, as it is easier than silk to apply and less expensive. It has ample strength in addition. Cover in small sections where necessary, such as the fuselage nose, wing stubs, etc. Be sure to cover thoroughly around all the cabin windows, using narrow strips. Cover all solid balsa parts such as the wing struts, and balsa block over windshield. When covering is completed, apply two coats of clear nitrate dope, brushed. In applying the color job to the gas model, use the spray method if at all possible. A much finer finish will result. In preparing the parts for the application of the pigmented dope, first cut some cabin window protectors from gummed paper. Round the corners off. (See photographs.) These are securely stuck to the windows. Be certain that all edges are actually adhering to the celluloid. Other items on the ship should be protected also with paper, such as the wheels, flight timer wind-up arm, etc.

The original is painted all white with bright red trim, which is a very effective and pleasing color scheme. Two sprayed coats of white pigmented dope were given the parts. Trim as desired with the contrasting color as soon as the other has dried. Use a brush for this work. To conclude the paint job, apply a coat of dark "Prism-Lac" type lacquer (novelty finish) if possible, to the inside of the cowl, motor mount and firewall. This is the type of finish usually put on the more modern aircraft instrument panels. If it can be secured in your neighborhood paint store, the application is well worth the while in such a place, as far as final appearance of the model is concerned.

Assembly

Mount the engine and fuel tank on the mounting plates first. Hook up the timer, ground and spark-plug wires. It is a good idea to check the engine
operation before the cowling is installed. If it is
running okay, proceed to put the cowl on. This is done
by first removing the lower cowl support rod. The
cowling, with sides raised, is now lowered over the
cylinder, with the needle valve removed and the
spark-plug wire guided through the hole provided as
cowl is lowered. Work it on, holding the two upper
cowl support rods away from their respective studs,
until they are in line and can be slipped on. Now put
the two upper stud nuts on and tighten. Connect the
spark-plug wire to the plug and put the needle valve
back in place through the cowl hole. Now fasten the
top stationary section of cowling to the rear cowl
support ring. The lower cowl support rod is now put in
place, the rear end being secured to the lower stud
with a nut and the front end to the cowl ring with a
6-32 screw. Remove the first motor mounting screw
from each plate preparatory to putting in the 3/16"
O.D. aluminum tubing bracers, which extend from the
bottom of the cowl ring to these first mounting screws.
The lower ends are secured to the front cowl ring with
3-48 screws and nuts. This concludes the cowl
installation.

The fin should slide in the fuselage on its pins
rather tightly. The stabilizer pins, previously prepared
and illustrated on Plate 5, are merely put through the
stabilizer fittings and fuselage and the nuts tightened.
The wing panels and also the landing gear ends of
the struts are held in place with lengths of brass wire
of such size that it will just pass snugly through 3/32"
O.D. tubing, such as that which runs across top of
fuselage under the hatch for the wing pins.

To connect the wing struts at the wing panels,
use two 3-48 or 2-56 brass screws and nuts. The
design of the wings and struts on this gas model
allows them to separate from each other should the
need arise. Also, as all parts are readily demountable,
the plane is easily carried in an automobile,
consuming little room.

Flying

The original model balanced for a flat glide
almost perfectly upon completion. A slight bit of
negative adjustment on the stabilizer was all that was
required. It is not too critical in obtaining the correct
glide, due to the long moment arm. The "Autoknips"
timer, as used on this gas job, has an average
run-down time of 45 seconds, which is excellent in
completing test flights.
20 Gauge (soft)

24 Ga. = 1/2 Hard

Landing for side panels (aluminum strip)

Alum. tubing cowl supports

Brass hinges

Center section 20 Ga.

Length of each side panel ~ 6 1/8" (leave slight overlap & trim to tight latch- ing, after rolling)

Two upper rods riveted in place

Supporting rods are detachable for cowl removal

24 Gauge (soft)

3-48 screws

Sht. Alum.

Exhaust manifold (sht. tin)

Seam brazed

Brass pieces brazed on

Side panel fasteners are snap type used on fruit or candy boxes

Section of bottom of cowl showing fastening method

Plate 4

Full size

All rivets in cowl are 1/16 Dia. x 1/8 Long - Alum.

1/8 Sht. Balsa

1/16 Aluminum tubing

Cowl support rod - make 3

Brass fasteners

E.J.W.
A Precision Contest Gas Job
Part No. 2

Final Data Which Will Enable You to Complete One of the Most Realistic and Reliable Little Fliers That Ever Turned a Propeller

BY
ELBERT J. WEATHERS

The engine compartment with cowling raised
The author and the completed ship, ready to fly
The model in full flight is realistic, stable and a fine performer

IN THIS second and concluding part, drawing Plates 4, 5, and 6 are included, covering the parts for completion of the plane.

The landing gear ribs are cut out and installed in the landing gear "V's" as shown on Plate 1. These are found on Plate 6. Make sure that all are secure. Corner braces between the ribs and wire may be put in for added cementing area. Cut two ribs from No. 24 galvanized sheet metal and solder well to the piano wire in the correct position. It will be noted that all landing gear ribs are put in parallel to the fuselage, the first one next to fuselage being the only exception. (L-1 follows fuselage longeron.) See Plate 2 for the wing strut fitting detail at the landing gear. Cut four
The battery box, coil and condenser mountings are installed in the fuselage at this point, preparatory to wiring. See Plate 6 for perspective view of battery box. After completing, cement it securely to the cabin floor and also against the 1/16" sheet balsa bulkhead. The coil mounting pieces are made from 1/8" sheet balsa and fit directly against the forward side of the battery box. The condenser mounting brackets are also cut from 1/8" sheet stock and cemented to the cabin floor. Use metallic cement in connection with the installation of the coil and condenser in their respective cradles.

Study the wiring diagram on Plate 1 before beginning the job. Use stranded flexible copper wire, insulated covering of course, in all wiring, with the exception of that between the motor-mount bulkhead MM and the engine, which should be of heavier variety, similar to type used for automobile spark plug wiring, as these three wires (ground, timer and spark plug) are exposed to the gas, oil, etc., which will form to the rear of any engine to some extent after engine has been running. The plug cable should be well insulated by all means.

May the writer point out that the booster batteries in this wiring system are right in on the main line with the flying batteries, which works the best of any method, inasmuch as the booster lines need only be pulled out after motor is running, the flying batteries carrying on in an uninterrupted circuit. To use a booster battery with this system, one merely inserts the booster plugs and turns ON the switch and the engine is ready to begin operation. When the main switch is turned OFF and booster leads are still inserted in plugs, the current from booster also terminates with that of the flying batteries in the fuselage.

Engine Cowl and Exhaust Manifold

In building the cowl, extreme care must be taken in all operations. This unit will give any gas model builder good practical experience in metal working. The N.A.C.A. type cowl, as used with this ship, will allow better cooling of the engine than the "in-line" type cowling, and it contributes greatly toward the final appearance of the model, giving it a real plane appearance, even to the side panels, which can be raised for inspection, fueling, etc., similar to the N.A.C.A. cowl on the latest Fairchild cabin plane.

The primary step in the cowl construction is to get the front ring made. This is "spun" on a lathe and due to the easy curve, anyone having access to a lathe can easily make it himself with a little care. If one is not in a position to make it, any metal-working concern in his vicinity which does metal spinning will make it, including the hardwood form, for a very nominal sum.

However, if one plans its forming, the first thing to do is to make a hardwood form, turned on a lathe. This should be finished to 4-3/4" diameter, minus double the thickness of the 20-gauge aluminum forming the ring. In other words, allow for the thickness of the metal in turning the wooden form so that the aluminum ring itself will be 4-3/4" diameter when completed.

Secure a sheet of very soft (grade used for spinning) 20-gauge aluminum and secure with four screws against the front face of the form. Leave the sheet amply large for completing the ring to the rear edge, but don't leave too much excess, as it will be bothersome in the spinning operation. Begin to work it around the curve very gradually, using a hardwood stick (about 1" x 1") with corners all rounded off and smooth. The stick must be long enough to reach under one arm so that sufficient leverage and pressure can be obtained with it. The lathe should be operating as fast as possible. After the metal has been completely worked around to the rear face of the wooden form, use a cut-off tool to remove the excess metal and to form the rear edge of the ring. The next step is to polish the ring to a plating finish, which is followed by the use of a narrow lathe tool in cutting through the metal on the front face to obtain the desired size opening (3-1/4" diameter.) The ring will then fall free from the form. Remove a section of a 1-7/16" circle as shown on cowl detail, Plate 4. This is of course the opening through which the cylinder passes. The holes required on the front face of the ring should be drilled next. The three large holes are 120 degrees apart.

The landing upon which the side panels rest, at their front edge, is riveted in place around the cowl ring as indicated on Plate 4. This discontinues at the cylinder hole. When done correctly, a 1/8" strip will remain for the side panels. Use small aluminum rivets, 1/8" long with 1/8" flat heads, in all small riveting done on the cowling. The spacing of them for fastening the strip just described is clearly shown on the front view of cowl. The center top section of the cowling is made and installed next. It is 20-gauge aluminum (soft.) First cut out the remaining section of the cylinder hole to match that in the ring. Prepare the hinge notches and holes, also the needle-valve and spark-plug wire holes. When all holes are completed, bend the piece to the proper curve required, considering that it is a 2" section of a 4-3/4" circle. The two small brackets
which secure the rear end of the top section to the rear cowl support ring are now riveted in place (one rivet each.) The hinges (which are purchased at any large hardware store) are to be riveted on this center section also, before riveting it to the spun ring. Cut the bracer C-1 and cement it in place with metallic cement.

Proceed to rivet the top center section to the cowl ring (actually the riveted strip.) Obtain some sheet aluminum stock, half hard preferably and 24-gauge, for the two side panels. The hardened variety is preferable so that the side pieces will be springy after being rolled to shape. Cut two pieces, size each 3-3/4" x 6-7/16", and remove the section through which the exhaust manifold passes. Drill and install the pair of fasteners on bottom ends of the two pieces. Also file the hinge slots and drill the hinge holes. When all of these operations are completed, take the panels to a sheet metal or tin shop and get them rolled in a rolling machine. Take along a tin can or other object which is about the cowl diameter to use in getting the panels to the exact size curve to conform with the 4-3/4" cowl diameter. Before going further, make the three cowl support rods from 3/16" O.D. aluminum tubing, as shown on Plate 4. Rivet the two upper ones permanently in the two upper holes in cowl ring. (The lower one is removable so cowlwiring may be removed with motor and tank in place.)

Now rivet the two side panels to the hinges. Trim each one slightly at this point so fasteners snap tightly, with each side panel just meeting and no more. Two 3/16" O.D. aluminum tubing brace rods are made to be used with the cowl. These extend from the two small holes, next to bottom cowl support-rod hole in front ring, to the first engine mounting screw hole in each engine mounting plate. Flatten the tubing and drill holes in the ends similar to the main cowl supportrods.

The metal ring supporting the cowling at the rear and the engine mounting plates (mounted on the hardwood beams) are shown on Plate 2.

Cut the ring from 20-gauge soft aluminum and punch holes, size 3/8", around the ring for passage of air. These can be drilled if no punch is available. Drill the four mounting screw-holes and also the two holes at the top to which the small brackets on the top section of cowl are attached. Mount the ring on the previously prepared aluminum tubing spacers with 5/8" round head wood screws.

The two engine mounting plates are of 24-gauge galvanized sheet metal. Drill the holes to match those previously drilled in the hardwood beams. The holes for the engine and tank mounting screws should be put in at the same time. (Check your own engine and tank holes for spacing against those on mounting plate illustration.) Bend each plate at right angle where indicated. Mount each one on the wooden beams with 6-32 machine screws (use dural screws and nuts if possible.)

The exhaust manifold, illustrated on Plate 4, is constructed of sheet tin (coffee can, etc.) over a balsa form. The seam is a simple lap joint, brazed. The exhaust manifold should fit tightly between the bottom cylinder fin and the intake jacket. File two brass pieces to the shapes shown and have them brazed to the sheet tin butt-joints. A little care must be taken in all brazing done on this unit as the tin is rather thin and a brazing torch can easily and quickly burn a hole in it if caution is not used. File the manifold smooth with rounded corners. Drill holes to accommodate 4-36 screws in the solid brass pieces as shown. The strap for holding the exhaust manifold in place is a 20-gauge strip of aluminum. It is suggested that the completed manifold be dull nickel-plated. This "hides" all brazing and gives a one-piece appearance.

An extension will have to be made on the engine needle valve so it may be operated through the cowl. This can be merely a brass screw soldered firmly on the head of the standard valve. Regarding the timer advancement with cowl in place. The writer has always been able to start his engine with the timer in fully advanced position, bringing the engine up to proper r.p.m. through carburetor adjustment only (needle valve.) However, this may not be the case with all power plants. If a timer extension through the cowl is necessary, it is suggested that a slot be cut in the cowl ring to operate an extension lever on the timer.

Tail Surfaces

Both the fin and stabilizer are of identical construction. See assembly drawing (Plate 1) for detail on empennage members.

Cut out the leading and trailing edges, tips and designated ribs from 1/16" sheet balsa of firm variety. All diagonal bracing is of 1/8" sq. balsa. The fin and stabilizer spars should be of very hard stock, especially the stabilizer spar. The dowel pins in fin are of hardwood and should be of such diameter (5/16" approximately) as to fit tightly in the aluminum tubing in the fuselage. The fin tab for torque adjustment is fastened in place with copper or brass wire hinges.

Cover the leading edge of both the stabilizer and fin with 1/32" medium sheet balsa. It is advisable to wet the sheet where it takes the abrupt bend on the actual leading edge of each tail member. The stabilizer fittings for securing it in place on the fuselage are clearly shown on Plate 5.

Wing Panels and Wing Struts
Select very hard, good quality, 1/8" sheet balsa for the wing spars. All other balsa in wings should be medium hard. Due to the up-curve on the wing tips (excellent insofar as lateral stability is concerned) and also the tapering of the wing panels at the fuselage end, the wing spars are rather irregular, being curved for these purposes. After cutting them from sheet stock, begin the cutting of the ribs, leading and trailing edges, and wing tips. To build a wing panel, first slide all ribs over the spars in their approximate positions. Now pin the spars in place over the full-size wing panel drawing. The ribs are now put in position and cemented. The trailing edge (1/8" x 3/8" balsa, tapered in cross-section) is laid down and cemented in place. The wing stubs at fuselage are carved from solid balsa blocks, as shown on assembly drawing, and are securely attached to wing ribs W-1. The wing strut fitting for the wings is shown full-size on Plate 3. The fittings for the wing panel pins, which are very securely attached to the stubs, as indicated are, like the wing strut fittings, formed from 20-gauge sheet aluminum. A hole, which 1/8" O.D. aluminum tubing will just pass through, is drilled through these wing stub fittings and the balsa stub after fittings have been cemented in place. The tubing is spread on each end and hammered over to form a strong rivet, as was done on the fuselage for the stabilizer pins, etc. Each wing panel is covered with 1/32" sheet balsa on the front section, the same as was done on the tail surfaces. Due to the curve at the ends of each wing panel, it will be found necessary to piece the veneer to a certain extent. The diagonal bracing is 1/8" x 1/4" balsa and gussets are added to the trailing edge at each rib for additional strength.

The wing struts are rather unusual in design. Each is formed from 1/2" sheet balsa stock, which should be medium hard. See assembly drawing for detail on this part. Carve and sand each one to the aerofoil shown on Plate 6. The fitting which slides in between the brass tubes on the landing gear is shown on Plate 4. This is riveted to the struts using 1/8" O.D. aluminum tubing in the same manner as the wing strut fittings. The metal fitting at the small end of the strut is shown on Plate 5. It is also riveted, as well as cemented, in same fashion as the fitting at the base of the strut, but 1/16" O.D. aluminum tubing is sufficient in this application.

Now we shall return to the fuselage for the installation of the windshield and side cabin windows. See Plate 6 for the windshield template. Get good sheet celluloid, preferably .015 thickness, for this work. Be sure it has no prominent scratches on the surface. Using the template, cut the windshield out and install it, using cement carefully so as not to smear the celluloid. Use pins until cement is dry. The side pieces of celluloid are cemented in next and each should be perfectly flush with the balsa surface of the fuselage sides, done by removing balsa around window frames the thickness of the celluloid (see assembly drawing for dotted lines showing this.)

On the original model the writer conceived the idea of shellacking the entire nose construction of the fuselage, from the firewall back to the windshield. This has proved to be most successful in the prevention of gas and oil softening cement joints in this vicinity. Engine fuel will eventually get to most parts of the nose on most any gas job, and by shellacking, no breakdown of cement at joints can possibly result from such a condition. So it is suggested that this be done at this time, just prior to covering the plane.

Covering and Finishing

The writer's model was covered with a good grade of bamboo paper, as it is easier than silk to apply and less expensive. It has ample strength in addition. Cover in small sections where necessary, such as the fuselage nose, wing stubs, etc. Be sure to cover thoroughly around all the cabin windows, using narrow strips. Cover all solid balsa parts such as the wing struts, and balsa block over windshield. When covering is completed, apply two coats of clear nitrate dope, brushed. In applying the color job to the gas model, use the spray method if at all possible. A much finer finish will result. In preparing the parts for the application of the pigmented dope, first cut some cabin window protectors from gummed paper. Round the corners off. (See photographs.) These are securely stuck to the windows. Be certain that all edges are actually adhering to the celluloid. Other items on the ship should be protected also with paper, such as the wheels, flight timer wind-up arm, etc.

The original is painted all white with bright red trim, which is a very effective and pleasing color scheme. Two sprayed coats of white pigmented dope were given the parts. Trim as desired with the contrasting color as soon as the other has dried. Use a brush for this work. To conclude the paint job, apply a coat of dark "Prism-Lac" type lacquer (novelty finish) if possible, to the inside of the cowl, motor mount and firewall. This is the type of finish usually put on the more modern aircraft instrument panels. If it can be secured in your neighborhood paint store, the application is well worth the while in such a place, as far as final appearance of the model is concerned.

Assembly

Mount the engine and fuel tank on the mounting plates first. Hook up the timer, ground and spark-plug wires. It is a good idea to check the engine
operation before the cowling is installed. If it is running okay, proceed to put the cowl on. This is done by first removing the lower cowl support rod. The cowling, with sides raised, is now lowered over the cylinder, with the needle valve removed and the spark-plug wire guided through the hole provided as cowl is lowered. Work it on, holding the two upper cowl support rods away from their respective studs, until they are in line and can be slipped on. Now put the two upper stud nuts on and tighten. Connect the spark-plug wire to the plug and put the needle valve back in place through the cowl hole. Now fasten the top stationary section of cowling to the rear cowl support ring. The lower cowl support rod is now put in place, the rear end being secured to the lower stud with a nut and the front end to the cowl ring with a 6-32 screw. Remove the first motor mounting screw from each plate preparatory to putting in the 3/16" O.D. aluminum tubing bracers, which extend from the bottom of the cowl ring to these first mounting screws. The lower ends are secured to the front cowl ring with 3-48 screws and nuts. This concludes the cowl installation.

The fin should slide in the fuselage on its pins rather tightly. The stabilizer pins, previously prepared and illustrated on Plate 5, are merely put through the stabilizer fittings and fuselage and the nuts tightened. The wing panels and also the landing gear ends of the struts are held in place with lengths of brass wire of such size that it will just pass snugly through 3/32" O.D. tubing, such as that which runs across top of fuselage under the hatch for the wing pins.

To connect the wing struts at the wing panels, use two 3-48 or 2-56 brass screws and nuts. The design of the wings and struts on this gas model allows them to separate from each other should the need arise. Also, as all parts are readily demountable, the plane is easily carried in an automobile, consuming little room.

Flying

The original model balanced for a flat glide almost perfectly upon completion. A slight bit of negative adjustment on the stabilizer was all that was required. It is not too critical in obtaining the correct glide, due to the long moment arm. The "Autoknips" timer, as used on this gas job, has an average run-down time of 45 seconds, which is excellent in completing test flights.