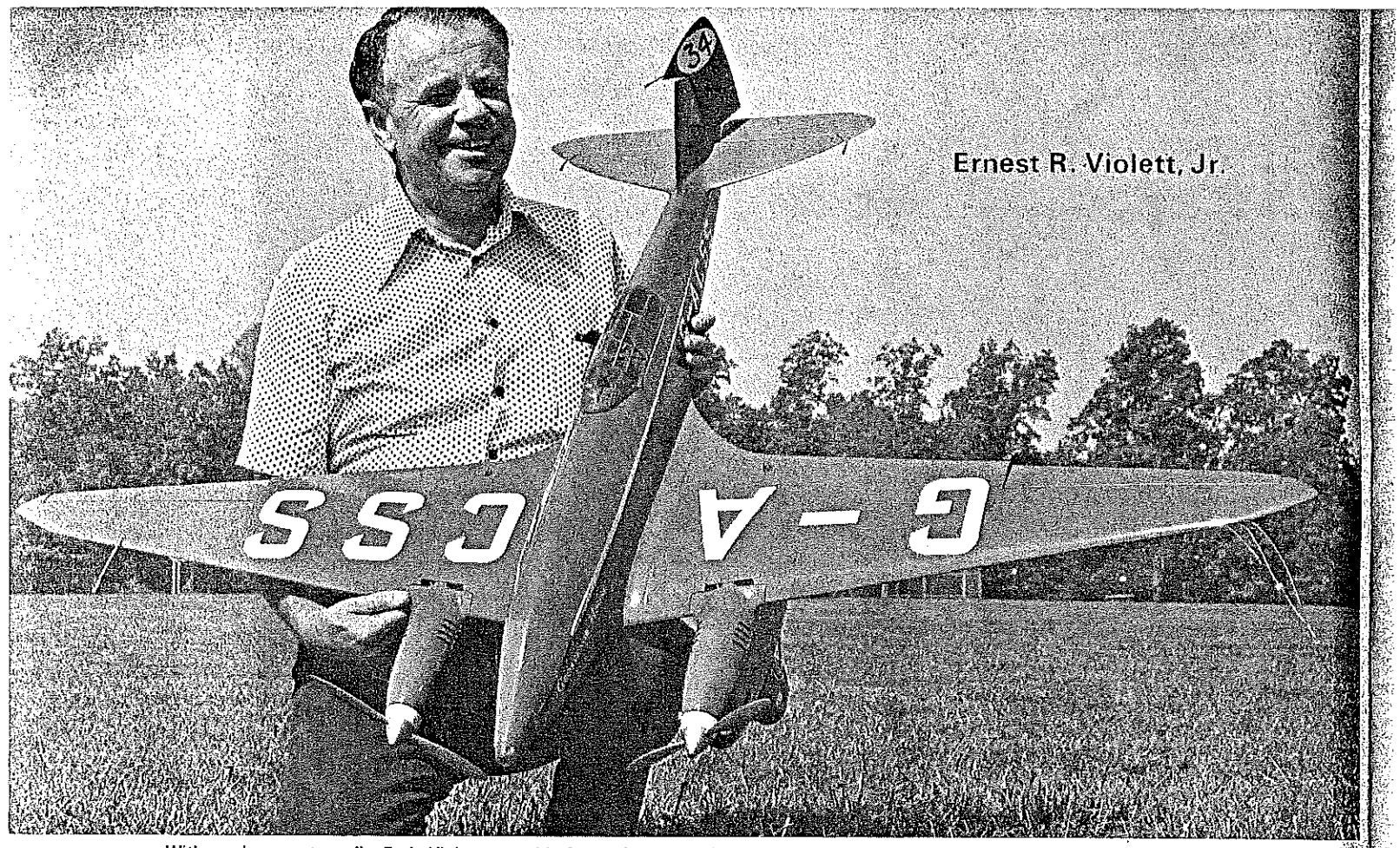


With good reason to smile, Ernie Violett poses his Comet for the *Model Aviation* photographer. Always a great favorite with modelers, the DH-88 is as beautiful today as it was in 1934 when it won the England to Australia air race. Solid red coloring is spectacular.

#114

The deHavilland Comet 88

MANY CONSTRUCTION articles for scale models warn the prospective builder that the model is for "experts" only. Your author does not believe in this theory. In my observations, many relatively inexperienced modelers or even beginners have more natural manual art skill than some modelers of many years experience. If you want to build this model and think you can, go ahead and build it. However, be sure you have the *desire* to build it. Most scale projects are time consuming, demanding, and require months of work. Without a burning desire to create the model, the builder will never finish the project.

The deHavilland Comet 88 was a unique airplane in its time. It was designed specifically as a long-range racing aircraft, intended solely for the McRobertsen air race from England to Australia in 1934. Only three aircraft were built. Of these aircraft, the red-and-white racer sponsored by Grosvenor House, a London hotel, was the winner. The aircraft later experienced a succession of owners who modified the craft in various ways. The aircraft is now on exhibit in the Shuttleworth Museum in England. Comparison of the museum aircraft with photos taken of the craft when first built and flown indicate that major changes were made by subsequent owners and in the last renovation.

These changes have deceived many draftsmen and model builders of the Comet 88, who evidently based their products on the Shuttleworth craft. As a result, these efforts do not depict the aircraft as it existed for the McRobertsen race. The author researched the aircraft for three years before enough data was gathered to make a scale project possible, and one having sufficient fidelity to scale. Preparation of a three-view plan was also necessary in order to avoid known errors in available scale plans. The scale drawing was authenticated by the AMA Technical Director as required by the AMA rules.

General Features: The model features retracting gear, flaps, throttle and brakes. Control of these devices, including elevator control, is achieved with only three flying lines, as detailed on the plans. An optional, fixed gear, is also shown on the plans.

The model is very fast on twin .35's, having been clocked at 53 mph. The construction, therefore, is rugged, so don't be tempted to cut corners to save weight. The author's model weighed 7¼ lbs. complete. The rugged construction is needed to handle twin engines and hard landings, but will also ensure many contest seasons without structural failure or stress cracks, particularly in the wing fillet area. Engines smaller than a .35 are *not* recommended since a model of this size and weight will not stay airborne on a smaller engine should one engine fail in flight, a common occurrence on twins.

Detailed, step-by-step instructions will not be described. Rather, the key elements in fabricating and assembly as well as special parts will be described in order to

avoid major errors. A thorough study of the plans and text, however, is a "must do" chore, after which construction should be no problem. The construction sequence is not too important, except where noted. The use of cellulose-acetate type model airplane glues is to be avoided in planking and all exterior joints or seams. Glues of this type continue to dry and shrink over a very long period, causing telltale lines in the finish. An aliphatic resin glue is suggested. The glue used must be sandable, so therefore do not use white glues.

Money can be saved on planking if the planking strips are cut from sheets. However, this is possible only if the builder has access to a small table saw, such as the Unimat, or other suitable devices.

Use medium-weight balsa for all structure members, and use soft, lightweight balsa for planking. Use light (contest grade) balsa for the tail surfaces. The plywood cores in the tail surfaces and the plywood inlay in the wing trailing edge permit sanding of all trailing edges to a sharp edge without the edge crumbling that would occur with a balsa-only trailing edge. The sharp edge is more to scale than thick edges of balsa.

Wing Construction: Wing construction should be preceded by fabrication of the landing gear cross shaft and retraction and counterbalance arm, the motor mounts, landing gear bearers and Part A, the main plywood support and connective member. (If a fixed gear arrangement is chosen, omit the cross-shaft and its associated parts.) The motor mount, bearing block, and landing gear bearers should be jig-drilled for the cross-shaft bearing sleeve holes and the landing gear strut shaft to ensure alignment and freedom from binding. The cross-shaft and all parts of the retracting gear *must* operate freely. Slide the motor bearers and bearing block on the cross-shaft and then silver solder in place the end and center retraction arms and spring counterbalance arms. A jig is recommended during the soldering operation to achieve proper positioning of the arms.

Jig assemble all of the aforementioned members directly on the plans, double-checking all alignments, and ascertaining freedom of cross-shaft rotation before gluing. Use epoxy glue and ½" no. 4 flathead screws for all joints. Do not add the wheel and strut assemblies until after all sanding is complete.

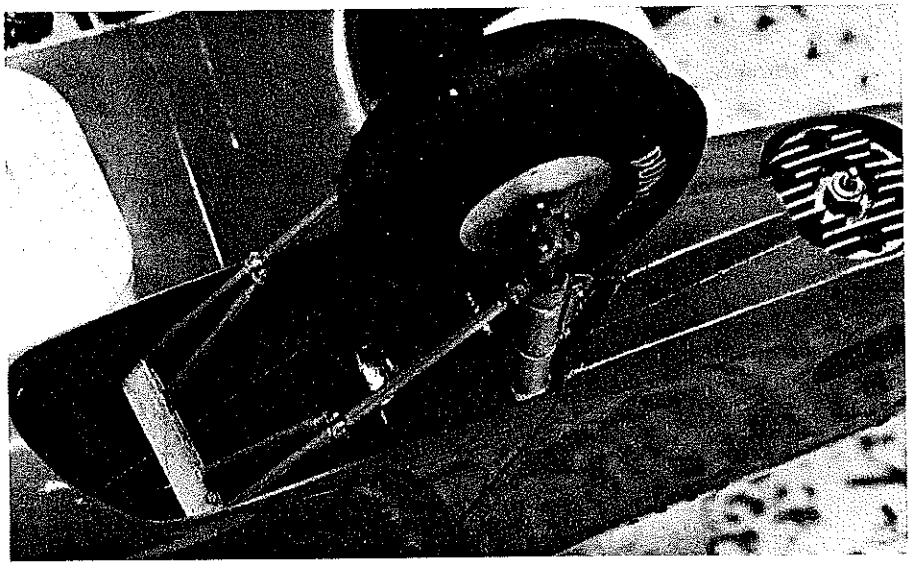
The wing is constructed in one piece, upside down, utilizing jig ribs in order to create the proper dihedral, wing rib incidence, and to elevate the wing above the work surface for clearance of the center retraction arm. Start by cutting out all ribs, jig ribs, wing tips, spars, dihedral gussets, and leading and trailing edges. The eight jig ribs are sufficient support, but the trailing edge of the regular ribs will have to be bench-supported to withstand the planking operation. Use a short length of ¼" sq. balsa for vertical supports, spot glued to the rib. The builder may opt to make all ribs as jig ribs. Refer to the jig base line shown on the front view to determine the proper height of the jig ribs. Mark the parting line in all jig ribs before using. Note the left wing tip of laminated bass and plywood. When making this tip, epoxy glue the aluminum guide tubes for the leadout wires. The leading edge should be tapered (slightly oversize), but not shaped. The trailing edges should be shaped prior to attaching the 1/32" ply

A Nationals winner, this magnificent twin is a durable, consistent flyer.

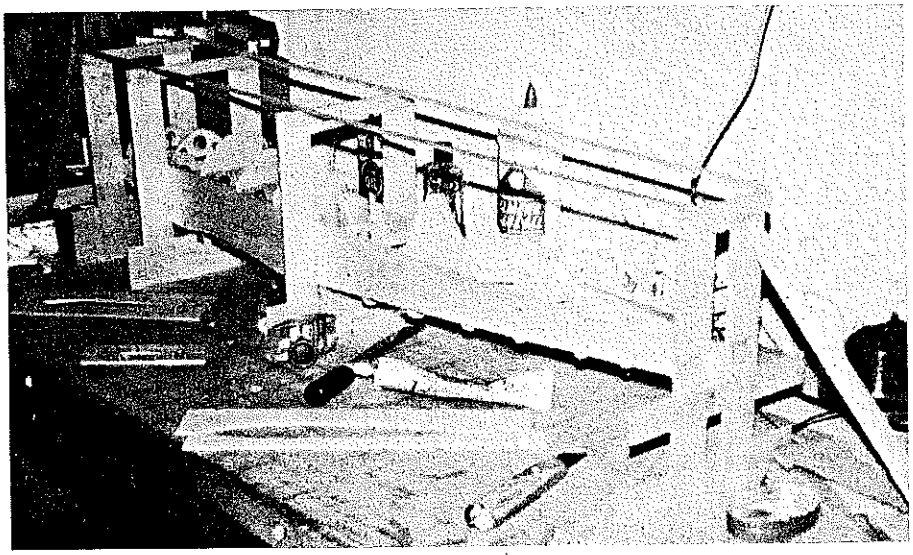
trailing edge inlay. Note that the 1/32" ply runs from the inboard edge of the aileron opening to the fuselage centerline, and in the vicinity of the fuselage, the 1/32" ply forms the base of the wing fillet which is added later. Assemble the two spar halves and dihedral brace before wing assembly.

Erect the jig ribs on the plan, using temporary blocking and bracing to position and hold in place. Line up the jig ribs with a straightedge. Pin and block the leading and trailing edge and spar in place. Glue in the wing tips. Glue in the rib pieces between the nacelles (outboard to outboard) and then install the Part A-motor mount-landing gear assembly. Add all remaining ribs and glue. Plank the wing, but don't forget to provide access hatches over the bellcrank area and the point of juncture of the aileron torque tubes. Construct the hatches from 2 plies of 3/32" hard balsa, glued with the grain at 90 degrees to each other. Outline the hatch opening and the hatch perimeter with 1/32" ply to prevent edge wear. Let the complete assembly dry at least 48 hours before removal from the bench.

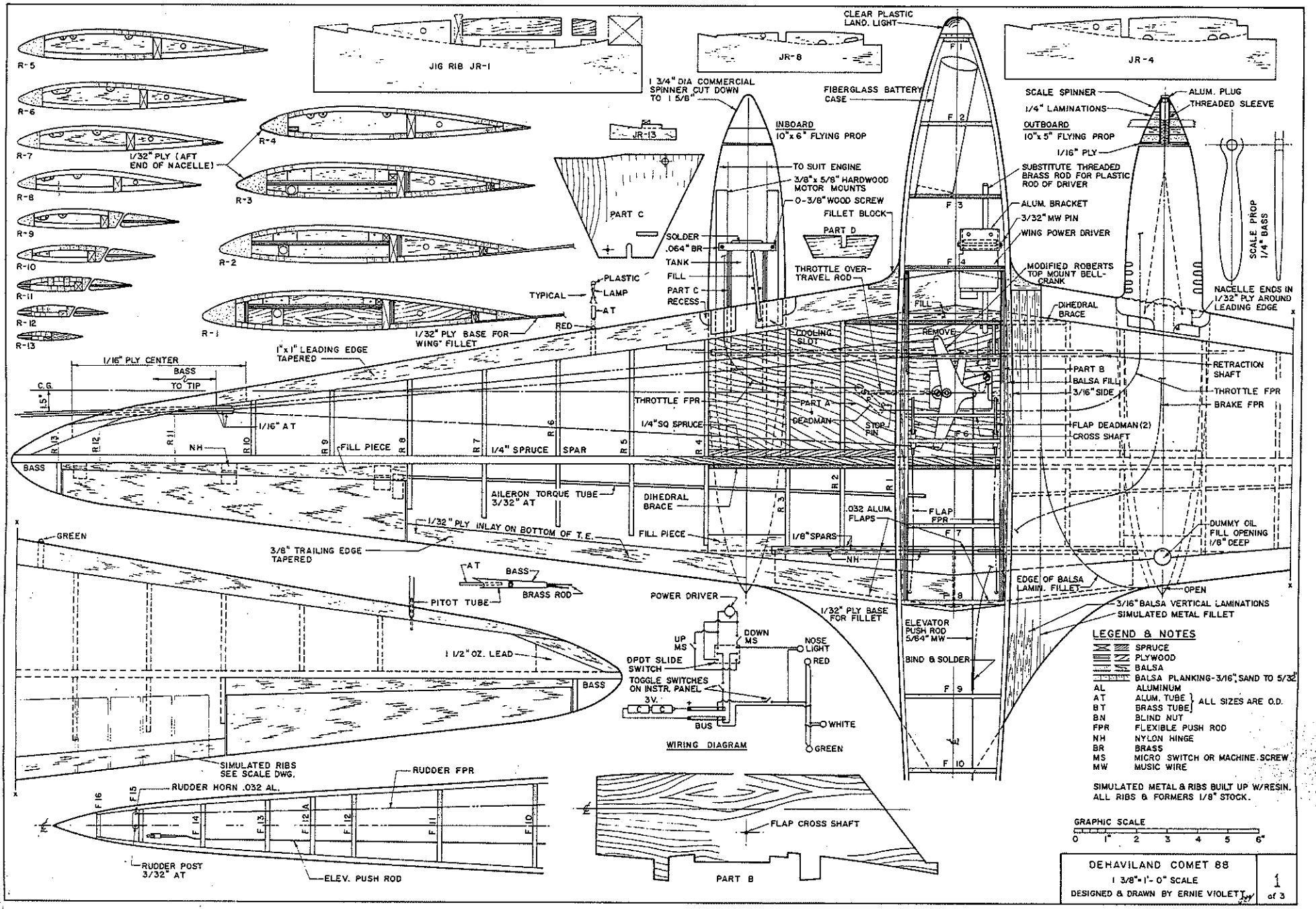
Remove the jig portion of the ribs at the parting line and sand the rib edges



Although the complicated retractable landing gear—of course it works!—is fully detailed in both the text and on the plan, there's nothing like a picture to help clarify things.



There's only one way to make a fuselage in exact alignment and that is to build a jig for its assembly. Here's the author's simple jig with a semi-completed fuselage being worked on.


R-5
R-6
R-7
R-8
R-9
R-10
R-11
R-12
R-13
1/32" PLY (AFT END OF NACELLE)
R-4
R-3
R-2
R-1
JIG RIB JR-1
JR-13
JR-8
JR-4
PART C
PART D
1 3/4" DIA COMMERCIAL SPINNER CUT DOWN TO 1 5/8"
INBOARD 10"x6" FLYING PROP
TO SUIT ENGINE
3/8"x 5/8" HARDWOOD MOTOR MOUNTS
0-3/8" WOOD SCREW
FILLET BLOCK
SOLDER .064" BR TANK FILL
PART C RECESS
THROTTLE OVER-TRAVEL ROD
CLEAR PLASTIC LAND. LIGHT
FIBERGLASS BATTERY CASE
SCALE SPINNER
1/4" LAMINATIONS
OUTBOARD 10"x5" FLYING PROP
1/16" PLY
ALUM. PLUG
THREADED SLEEVE
SUBSTITUTE THREADED BRASS ROD FOR PLASTIC ROD OF DRIVER
ALUM. BRACKET
3/32" MW PIN
WING POWER DRIVER
MODIFIED ROBERTS TOP MOUNT BELL-CRANK
SCALE PROP 1/4" BASS
NACELLE ENDS IN 1/32" PLY AROUND LEADING EDGE
DIHEDRAL BRACE
COOLING SLOT
REMOVE
PART B BALSA FILL 3/16" SIDE
RETRACTION SHAFT
THROTTLE FPR
BRAKE FPR
FLAP DEADMAN (2) CROSS SHAFT
TYPICAL PLASTIC LAMP AT RED
1/32" PLY BASE FOR WING FILLET
1"x1" LEADING EDGE TAPERED
1/16" PLY CENTER
BASS TO TIP
C.G. 1.5"
1/16" AT
NH
FILL PIECE
1/4" SPRUCE SPAR
THROTTLE FPR
1/4" SQ SPRUCE
PART A DEADMAN
STOP PIN
AILERON TORQUE TUBE 3/32" AT
DIHEDRAL BRACE
FILL PIECE
1/32" PLY INLAY ON BOTTOM OF T.E.
3/8" TRAILING EDGE TAPERED
.032 ALUM. FLAPS
FLAP FPR
1/8" SPARS
NH
DUMMY OIL FILL OPENING 1/8" DEEP
EDGE OF BALSA LAMIN. FILLET
OPEN
3/16" BALSA VERTICAL LAMINATIONS SIMULATED METAL FILLET
1/32" PLY BASE FOR FILLET
ELEVATOR PUSH ROD 5/64" MW
BIND & SOLDER
GREEN
AT
BASS
BRASS ROD
PITOT TUBE
1 1/2" OZ. LEAD
SIMULATED RIBS SEE SCALE DWG.
POWER DRIVER
UP MS
DOWN MS
NOSE LIGHT
RED
DPDT SLIDE SWITCH
TOGGLE SWITCHES ON INSTR. PANEL
3V.
BUS
WHITE
GREEN
WIRING DIAGRAM
RUDDER FPR
RUDDER HORN .032 AL.
RUDDER POST 3/32" AT
ELEV. PUSH ROD
FLAP CROSS SHAFT
PART B
LEGEND & NOTES
SPRUCE
PLYWOOD
BALSA
BALSA PLANKING-3/16", SAND TO 5/32"
AL ALUMINUM
AT ALUM. TUBE
BT BRASS TUBE
ALL SIZES ARE O.D.
BN BLIND NUT
FPR FLEXIBLE PUSH ROD
NH NYLON HINGE
BR BRASS
MS MICRO SWITCH OR MACHINE SCREW
MW MUSIC WIRE
SIMULATED METAL & RIBS BUILT UP W/RESIN. ALL RIBS & FORMERS 1/8" STOCK.
GRAPHIC SCALE
0 1" 2 3 4 5 6"
DEHAVILAND COMET 88
1 3/8"=1'-0" SCALE
DESIGNED & DRAWN BY ERNIE VIOLETT
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smooth. Modify the Roberts bellcrank as described on the plans and install on Part A with blind nuts. Install the throttle, flexible pushrods, deadman crank and stop pin. The over-travel arrangement on the throttle pushrod, detailed on the plans, permits activation of the landing gear switch after full throttle is reached. This switch is a double-pole, double-throw, slide type. The tension spring shown ensures return of the slide to the down position, which takes place upon a slight reduction in the throttle setting.

Install the leadout cables, wing weight, brake flexible pushrod, aluminum tubes for running lights, wiring, and aileron torque tubes. Check all items for secure installation, freedom of moving parts, and electric continuity of wiring. When satisfied *everything* is in place and in working order, plank the top of the wing. Glue in the filler strip between the aileron and the spar. Make up the aileron ply and balsa sandwiches, and tack glue in place. The nylon hinges should be glued into the ailerons only at this time. Use balsa spacers, spot glued, to achieve the necessary clearance between the ailerons and wing, and center the ply core of the ailerons with the wing trailing edge and the wing tip. When dry, sand the wing to the proper airfoil section using templates to check for accuracy. When sanding is completed, cut the ailerons loose at the tack-glued balsa spacers, and store until finishing begins.

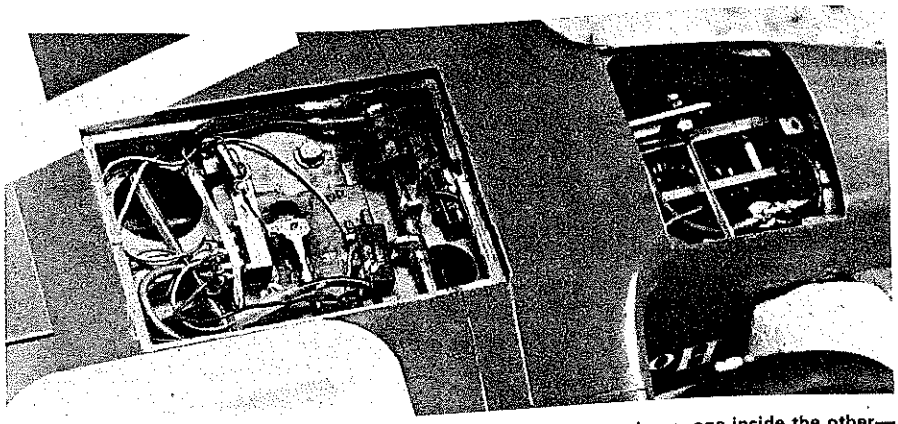
Fuselage Construction: Begin by cutting out all formers, fuselage sides and part B (two required). Glue a balsa fill piece to the outboard side of the two part B pieces. Shape the filler pieces according to the plan view. Jig construction is recommended. Build a jig of scrap balsa directly over the plan that will maintain vertical alignment of the fuselage sides and establish the fuselage width. Glue the fuselage sides to part B. When dry, insert the sides into the fuselage jig, wedging the sides tight against the jig frame with insertion and gluing of the fuselage formers. Do not forget to insert the flap deadman cranks and cross-shaft when the sides are placed in the jig. Install some temporary diagonal braces between formers (in plan view) to prevent warps when the structure is removed from the jig.

When dry, remove from the jig and install the elevator pushrod, tail skid, all wiring, rudder and elevator controls, flap flexible pushrod, and flap cross-over arm. The bulkhead holes for these devices are not shown on the plans, but are left to the builder's choice in routing. Install the retraction motor support at this time, but not the motor. Construct the battery case from fiberglass cloth and resin, using a dowel slightly larger than battery diameter as a mold. Install battery case and all required contacts and connect to the wiring. Make and fit the dummy interior sides of the cockpit, instrument panel and cockpit floor, but do not install these items. Store until painting is completed. Check all moving parts for freedom, and the wiring for electrical continuity. Plank the top of the fuselage, but not the bottom.

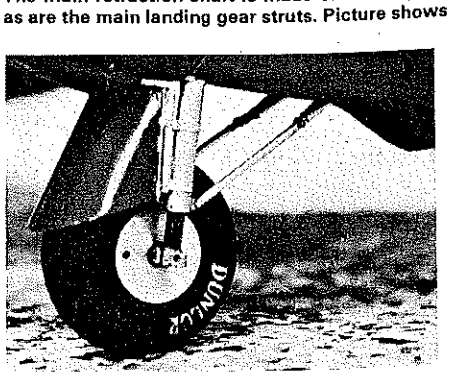
Assemble the fuselage to the wing by inserting the tabs or projections of part B into part A. Glue the tabs well after checking the wing alignment with the fuselage.

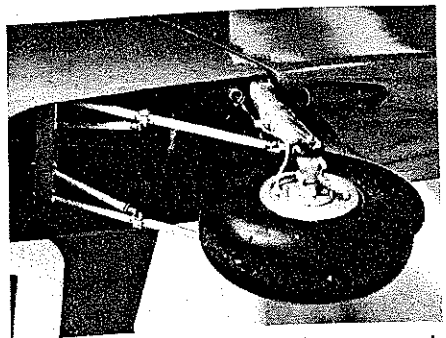
Plank the bottom of the fuselage including the retraction gear access hatch area. Fair the bottom planking into the wing, maintaining the fuselage profile. Sand all planking, using cross-section templates to achieve the proper shape. Cut out the access hatch and install suitable formers on the hatch interior face to maintain the shape. Line the hatch opening and the hatch perimeter with 1/32" ply to protect the edges against wear.

Begin the wing fillet construction by marking the fillet outline on the fuselage side and on the top of the wing. Insert a rectangular block in the wing leading edge at the root as shown. Cut the fillet vertical laminations from very soft 3/16" balsa and pin and glue in place one layer at a time. When dry, carve and sand the fillet, using templates to achieve the correct

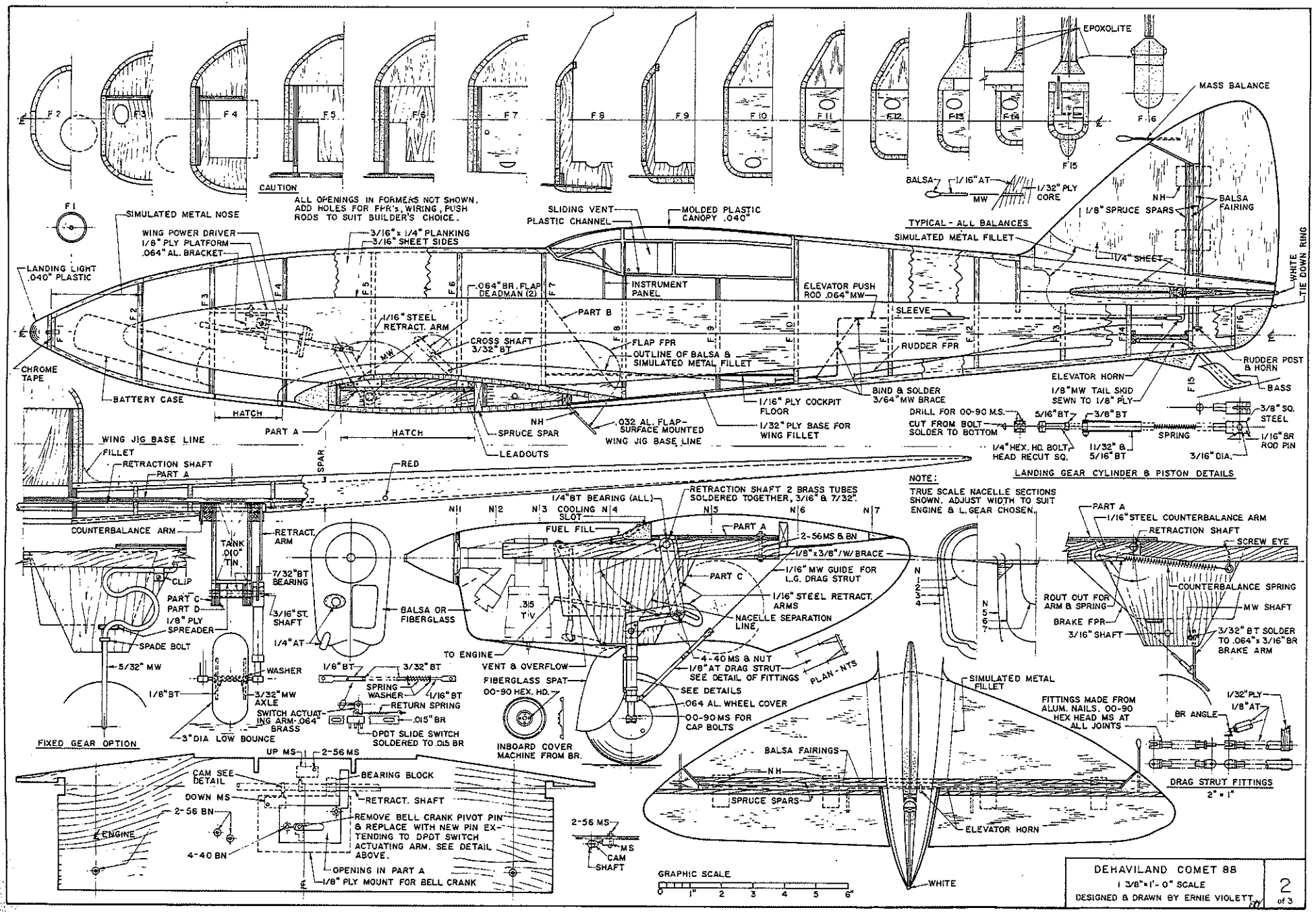


The main retraction shaft is made of telescoping brass tubing—two pieces, one inside the other—as are the main landing gear struts. Picture shows mechanism in center of fuselage.





Above: Landing gear in the extended position. Right, above: The landing gear strut pistons are made from 3/16 in. steel bolts. Below: The Comet with the Sterling Models Award for the Outstanding Scale model at the Nationals irrespective of event. "The best of show."


F2
F3
F4
F5
F6
F7
F8
F9
F10
F11
F12
F13
F14
F15
F16
CAUTION
ALL OPENINGS IN FORMERS NOT SHOWN. ADD HOLES FOR FPR's, WIRING, PUSH RODS TO SUIT BUILDER'S CHOICE.
EPOXOLITE
MASS BALANCE
BALSA
1/16" AT
MW
1/32" PLY CORE
TYPICAL - ALL BALANCES
NH
BALSA FAIRING
1/8" SPRUCE SPARS
SIMULATED METAL FILLET
1/4" SHEET
WHITE TIE DOWN RING
SIMULATED METAL NOSE
WING POWER DRIVER
1/8" PLY PLATFORM
.064" AL. BRACKET
3/16" x 1/4" PLANKING
3/16" SHEET SIDES
SLIDING VENT
PLASTIC CHANNEL
MOLDED PLASTIC CANOPY .040"
LANDING LIGHT .040" PLASTIC
.064" BR. FLAP DEADMAN (2)
INSTRUMENT PANEL
ELEVATOR PUSH ROD .064" MW
SLEEVE
1/16" STEEL RETRACT. ARM
CROSS SHAFT 3/32" BT
PART B
FLAP FPR
OUTLINE OF BALSA & SIMULATED METAL FILLET
RUDDER FPR
CHROME TAPE
BATTERY CASE
HATCH
PART A
SPRUCE SPAR
.032 AL. FLAP SURFACE MOUNTED
WING JIG BASE LINE
1/16" PLY COCKPIT FLOOR
1/32" PLY BASE FOR WING FILLET
BIND & SOLDER 3/64" MW BRACE
ELEVATOR HORN
1/8" MW TAIL SKID SEWN TO 1/8" PLY
RUDDER POST & HORN
BASS
DRILL FOR 00-90 M.S.
CUT FROM BOLT
SOLDER TO BOTTOM
5/16" BT
3/8" BT
1/4" HEX. HD. BOLT HEAD RECUT SQ.
11/32" ø 5/16" BT
SPRING
3/8" SQ. STEEL
1/16" BR ROD PIN
3/16" DIA.
LANDING GEAR CYLINDER & PISTON DETAILS
WING JIG BASE LINE
FILLET
RETRACTION SHAFT
PART A
SPAR
RED
NOTE:
TRUE SCALE NACELLE SECTIONS SHOWN. ADJUST WIDTH TO SUIT ENGINE & L.GEAR CHOSEN.
COUNTERBALANCE ARM
TANK .010" TIN
RETRACT. ARM
7/32" BT BEARING
3/16" ST. SHAFT
1/4" AT
CLIP
PART C
PART D
1/8" PLY SPREADER
SPADE BOLT
5/32" MW
WASHER
1/8" BT
3/32" MW AXLE
SWITCH ACTUATING ARM-.064" BRASS
3" DIA LOW BOUNCE
FIXED GEAR OPTION
BALSA OR FIBERGLASS
1/8" BT
3/32" BT
SPRING WASHER
1/16" BT
RETURN SPRING
.015" BR
DPDT SLIDE SWITCH SOLDERED TO .015 BR
N1
N2
N3 COOLING SLOT
N4
N5
N6
N7
1/4" BT BEARING (ALL)
RETRACTION SHAFT 2 BRASS TUBES SOLDERED TOGETHER, 3/16" & 7/32"
FUEL FILL
PART A
2-56 MS & BN
1/8" x 3/8" W/ BRACE
1/16" MW GUIDE FOR L.G. DRAG STRUT
PART C
1/16" STEEL RETRACT. ARMS
.315 T.V.
NACELLE SEPARATION LINE
TO ENGINE
4-40 MS & NUT
1/8" AT DRAG STRUT SEE DETAIL OF FITTINGS
PLAN - NTS
VENT & OVERFLOW
FIBERGLASS SPAT
00-90 HEX. HD.
SEE DETAILS
.064 AL. WHEEL COVER
00-90 MS FOR CAP BOLTS
INBOARD COVER MACHINE FROM BR.
PART A
1/16" STEEL COUNTERBALANCE ARM
RETRACTION SHAFT
SCREW EYE
COUNTERBALANCE SPRING
ROUT OUT FOR ARM & SPRING
MW SHAFT
BRAKE FPR
3/16" SHAFT
3/32" BT SOLDER TO .064" x 3/16" BR BRAKE ARM
SIMULATED METAL FILLET
FITTINGS MADE FROM ALUM. NAILS. 00-90 HEX HEAD MS AT ALL JOINTS
1/32" PLY
1/8" AT
BR ANGLE
DRAG STRUT FITTINGS
2" = 1"
BALSA FAIRINGS
NH
SPRUCE SPARS
ELEVATOR HORN
WHITE
UP MS
2-56 MS
CAM SEE DETAIL
BEARING BLOCK
DOWN MS
RETRACT. SHAFT
2-56 BN
ENGINE
4-40 BN
REMOVE BELL CRANK PIVOT PIN & REPLACE WITH NEW PIN EXTENDING TO DPDT SWITCH ACTUATING ARM. SEE DETAIL ABOVE.
OPENING IN PART A
1/8" PLY MOUNT FOR BELL CRANK
2-56 MS
MS CAM SHAFT
GRAPHIC SCALE
0 1" 2 3 4 5 6"
DEHAVILAND COMET 88
1 3/8" = 1'-0" SCALE
DESIGNED & DRAWN BY ERNIE VIOLETT
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shape. Feather the fillet edge into the fuselage and wing surfaces until the fillet outline marking is just exposed.

Nacelles: The nacelles may be either fiberglass or balsa. The original model used the latter. In either case, check carefully on the required interior width needed to accommodate your engine and landing gear assembly (retractable or fixed). The nacelle cross-sections shown on the plans are true scale, and may have to be widened to suit your engine/gear set-up.

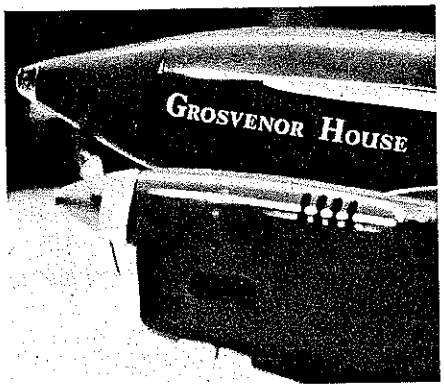
If fiberglass is chosen, use two longitudinal halves. Include stiffening ribs where necessary, and mold in the plywood nose ring (behind the spinner). Also mold in the 1/32" ply piece around the leading edge of the wing.

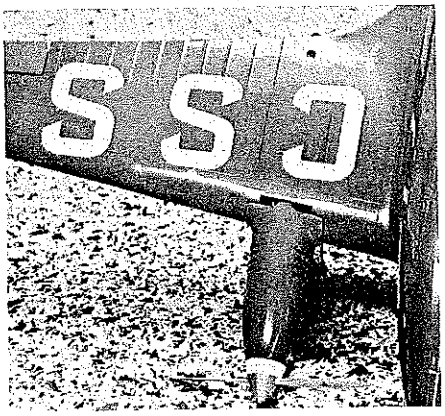
Use heavy cloth, or several layers of light cloth. After molding and joining the two halves, cut into two sections as indicated by the nacelle separation line. Shim the finished cowl away from the motor bearers with bass stock trimmed to fit and epoxied in place. Fasten the front half of the nacelle to bass shims with small flathead machine screws. It is best to epoxy a matching nut into the bass block to receive the machine screw. Locate the screws to coincide with the scale location of the cowling fasteners. Cut out exhaust and needle valve openings. Fasten the rear half of the nacelle as shown by the plans.

The balsa version is constructed of sheet sides and balsa blocks fitted between the sides. The blocks should be divided into two halves along the nacelle longitudinal center, and spot glued for separation. Begin by accurately cutting the side pieces to profile shape, and cut to match the curvature of the wing. Cut out and position the 1/32" ply piece around the wing leading edge. Insert and glue the blocks between the sides, holding with rubber bands until dry. Separate at the spot-glued points along the centerline, remove from the model, and rejoin by spot gluing. Carve and sand to shape. Separate the halves once again and hollow out the interior. Glue the halves together and then cut along the nacelle separation line. Fasten to the motor mounts as described for the fiberglass version. Trim 1/32" off the top edge of the nacelle and glue on a 1/32" ply lip, projecting 1/4" beyond the cowling to form a base for the fillet. Form the fillet from Epoxolite and sand smooth.

Note: The vent openings on the cowl sides, at the wing juncture, and at the extreme rear of the nacelle must be provided. These openings provide for the exhaust of cooling air from the engine when the wheels are in the retracted position. They are also recommended for the fixed gear version.

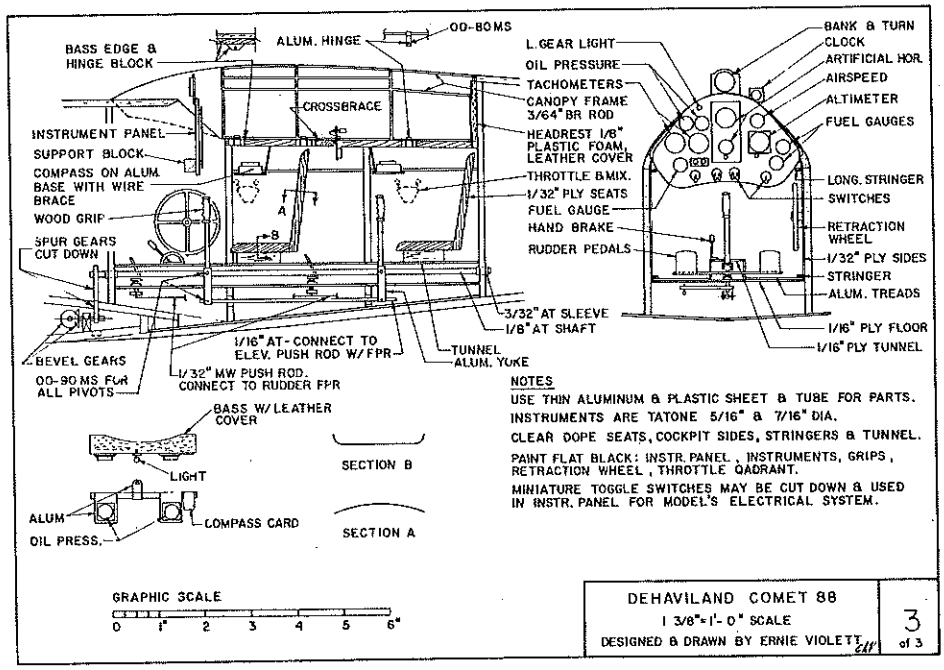
Tail Surfaces: The tail surfaces are all similar; i.e., a 1/32" ply core, faced with soft balsa laminations. Ply cores must have all cut-outs made for hinges, control-horn arms, and mass balance aluminum tubes prior to lamination. After lamination, add the spruce spars and balsa fairings as shown. Fasten the hinge in the fixed surface only at this time, thus permitting separation of the surfaces for final shaping, sanding and finishing. Add the rear fuselage block, slotted for the rudder ply projection. Add the fixed tail surfaces, sand the fuselage block to shape, and add the fillets, using Epoxolite.





Above: Over three years of research went into project before work began. Below: The engine nacelles are made from fiberglass or balsa.

Only the projecting needle valve knob betrays the model. Note righthand-turning props which also is scale. Inboard prop has 1 in. more pitch.



Landing Gear: The retreacting gear is more simple than it appears. It is of the self-locking type. The main retraction shaft is made of telescoping brass tubing, two pieces one inside the other, as are also the main landing gear struts. Easily available materials and parts are used, and machining is held to a minimum.

continued on page 66

deHavilland Comet 88

continued from page 17

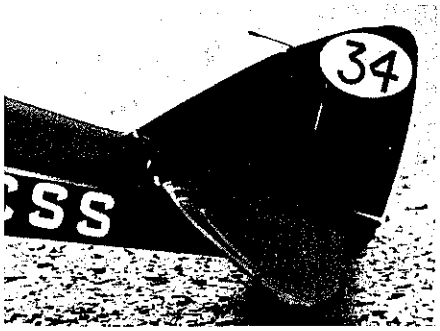
The telescoping tubes are fastened together by soldering to make one double-layered tube. Accomplish this by cutting the outer piece to the required length, and cut the inner piece several inches longer. Clean the tubes with acid and then assemble with the inner tube projecting out each end of the shorter tube. Apply heat by a torch to the outer end and then apply solder. Work the heat down the tube to draw or sweat the solder the length of the tubes. Work from both ends. When soldered together thus, the two tubes have more strength than a single tube. Cut the excess ends off the assembled tubes and add the fittings and bands indicated in the plans. Do not solder the interior bottom-stop band on the strut cylinder until later.

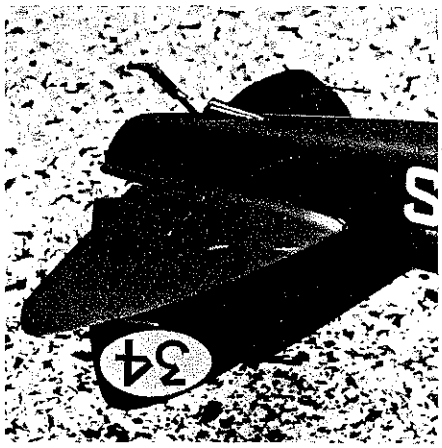
The landing gear strut pistons are made from 3/16" steel bolts. Bolts having a long unthreaded shank are required. Machine the bolt head as shown on the plans. This is best done by milling, but can be accomplished by hand cutting and filing if done carefully. Drill the head for the wheel axle, and the four small holes for the dummy cap bolts. The stop (or band) on the top of the piston and the stop on the bottom of the cylinder must be assembled together as follows. Cut a ½" length of tubing and slip over the piston. Cut another length of tubing the exact width of the piston stop and solder onto the piston. Do not solder the ½" long piece. Mark the stop width on the ½" piece (upper end) and insert the piston into the cylinder until the mark is even with the end of the cylinder. Carefully solder the stop into the cylinder. Slip the piston up into the cylinder during this operation to avoid melting the solder on the piston stop. After soldering, cut off the exposed part of the ½" long tubing from the piston, and dress up the end of the cylinder with a file.

Cut the upper cylinder fitting from 3/8" sq. steel bar and turn the round shank for a fit into the top of the cylinder. Drill the shaft and pinning holes and then cut the slot for the retraction arm.

Cut the retraction and counterbalance arms from 1/16" steel plate. A good material source is the blank steel covers sold for residential electric junction boxes.

Assemble the shock struts, springs and the upper cylinder fitting, pinning the latter in place. Clean all joints with acid before assembly. Assemble the cylinders onto the cross-shaft and sleeve, including washers. Add the wheel and axle. A jig is recommended for accurate alignment. Protect the tire and wheel with asbestos sheet and then silver solder all joints of the axle, cross-shaft, upper fitting/retraction arm and the cylinder. Keep heat off the 2-tube layered cylinder as much as possible. When finished, clean all assemblies with baking soda mixed with water.





Above: Real ship bore racing numeral "34." Note also the small mass rudder balance which projects forward. Right: The same area but inverted shows stabilizer fairing detail and the tail skid as installed on actual airplane.

Do not silver solder the retraction arms and counterbalance arms on the retraction shaft until assembly of Part A, motor mounts and landing gear bearers (Part C), as described earlier. The landing cylinder/piston assemblies are assembled into Part C by placing them in the U-shaped notches and then installing Part D. Screw and epoxy Part D to Part C. Once the landing gear assemblies are in place, install the counterbalance spring. The spring size, length, and tension are determined by trial and error to suit the weight of the specific wheel and strut assembly. The spring should be such that the gear will go up and down easily with a minimum of applied force. This is a critical adjustment, and affects the load the retraction motor must overcome.

The retraction motor may be a Wing Power Driver, or any similar device of the builder's chosing. If the Wing unit is chosen, remove the threaded plastic driving rod and replace with a threaded brass rod with the same thread. The plastic rod has a tendency to bend. The brass can usually be found in hardware stores.

With the retraction motor installed, connect up a temporary but fresh 3V battery power source and check the operation of the entire retraction system. There should be no binding, slow downs, or stalls. Check for operation in both up and down modes. With everything working satisfactorily, install the up-down limit micro-switches, actuating cams and wiring. Check for operation again, setting the limit switches to obtain the exact degree of up-down travel.

Fuel Tanks: The fuel tanks are made of .020" tin stock. Carve a soft pine model slightly undersize and use it for marking and forming the tank sides and ends. Use the mold to assemble and solder all parts except one of the sides. Remove the mold and solder the remaining side. Cut openings and install all tube fittings. Plug the tube openings and pressure test with air with the tank submerged in water. Clean tank with baking soda and water to remove all soldering acid. The tank rests between Parts C and on the spreader bar between them. The tank is secured in place by the brass strip soldered to the tank and screwed to the top of the motor mounts. Use a fuel filter between the tank and carburetor.

Canopy: The canopy is molded from .040" plastic sheet. Use the standard approach, described before in many publications, of attaching the sheet to a frame, heating the sheet in an oven, and forcing down over a male mold of the canopy. The best success is had if the vacuum molding process is used. Make at least two canopies while you're at it in order to provide a spare.

The canopy exterior frame can be simulated by the use of colored striping tape, or can be made by making a second canopy of .015" sheet directly over the first canopy. The windows of the second canopy are then cut out, leaving only the frame outline, which is then painted and glued to the main canopy. Cut out the sliding vent opening, make vent panes of .040" sheet, and install in U-shaped plastic tracks glued to the canopy. These tracks are made from small plastic channel, sold as structural shapes in hobby shops.

Make the canopy interior frame of 3/64" brass rod, soldered together. Use the canopy mold, slotted to receive the brass rod, as a jig for bending the rod and for solder assembly. Using fine copper wire, sew the interior frame to the canopy. Make three canopy hinges of aluminum stock and fasten to the cockpit rim with hex-head machine screws. The nose landing light enclosure is made by the same method as the canopy.

Finishing: As usual, the finishing method is the builder's option. The author's model was finished with lightweight glass cloth and surfacing resin. Color coats were polyurethane enamel. This enamel has very good hiding power and colors do not bleed. Hence, only three color coats (red) were used, and all white markings were added directly on top of the red. If a dope finish is chosen, the white will have to be applied first, masked-out, and the red coats applied last in order to avoid the bleeding problem of putting white dope over red. The color is signal-red with white markings. See "Scale Information" section for more on the color. (This section comes with the plans.)

After finishing the model with surfacing resin and sanding smooth, add all sur-

face details, such as the wing and tail fillets, metal nose section, cowl fasteners, wing ribs, etc. The fillets and wing ribs, etc., are created by masking off the required area with a double layer of masking tape, and building up the surface with several coats of surfacing resin. Sand the resin smooth down to the tape surface. Remove the tape and clean up any resin that leaked under the tape and any tape residue. Coat all exposed parts of the motor mounts and landing gear bearers with regular polyester resin.

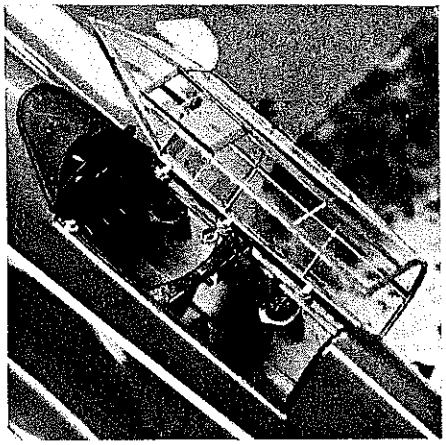
Simulate pinked tape on the ribs by tearing strips of tracing vellum along the sawtooth cutting edge of a wax paper or plastic wrap box. Wet the strips with water to make them pliable and glue down with thinned white glue. Add the rib stitching by applying thin beads of white glue crosswise on the rib at 3/8" intervals.

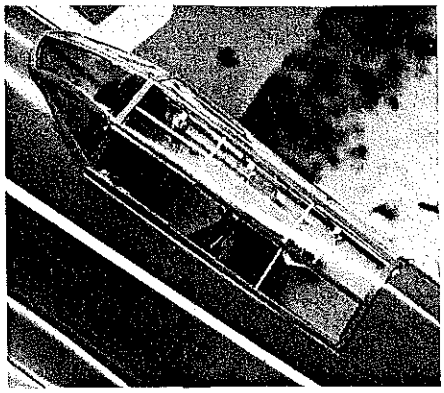
Use brass, flat-head machine-screw heads to simulate all fasteners or use a tool to score the circles and then score a line across the center of each circle. Using a sharp Xacto knife, score the panel separations on the top and bottom of the wing. Score the fuselage fuel filler caps with a small drafting divider instrument. Protect the finish from the center point by using several layers of masking tape.

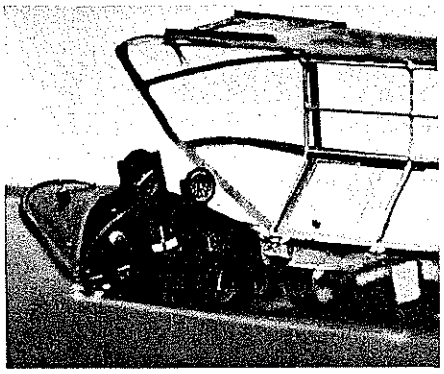
When all detail is completed, spray three thin coats of enamel (thinned 50%), allowing overnight drying between coats. Spray in as dustfree an area as possible. Sand between coats as necessary. Use a tack rag before all applications of paint. Allow the final coat to dry three to five days and then mask off and spray all markings. Contact paper (white or yellow) makes a good masking material for this type of work. The design can be drawn directly on the Contact and then cut out. The masking must be removed while the enamel is still wet in order to avoid a ragged paint edge. The wet paint will "round off" at the edges and provide a smoothly finished edge to the numeral or stripe. When all white markings are completed, apply the black numerals to the rudder using the same masking and removal process described above. Rub flat black paint into all panel score marks to accentuate the marking.

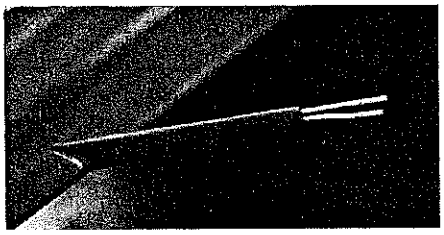
Use white transfer type lettering (Letraset, Instantype, etc.) for the name "Grosvenor House." White Instantype "Times Roman Bold" L1122 and L1554, in 48- and 30-point sizes, were chosen by the author for use on the original model. Two layers of the letters are necessary to achieve sufficient opacity. Spray three to four very thin "dusting" coats of polyurethane clear varnish over the letters to protect them. Do not use a "wet" coat, and allow to dry between coats.

Cockpit: To this writer, the cockpit is the most taxing part of any scale model. There are rarely any detailed drawings to follow, only photographs. The photographs were, by necessity, taken from outside the cockpit and are at odd angles, distorting size, location and perspective of interior features. For these reasons, the cockpit is a real workout for the builder's imagination and ingenuity. For this reason, as many details as possible are included in this presentation. The builder should supplement this by any photos he can obtain. See Part II (with the plans) for scale information sources.









Above: Opened canopy reveals some cockpit detailing. Top, right: Hinged canopy shut is as neat as big ship's. Below: The pitot just as it was. Right: The instrument panel close up.

Start the cockpit by fabricating the flight controls, using aluminum tube and sheet wood, and brass machine screws to make the parts as indicated. Install this system into the aircraft, but omit these items, such as rudder pedals, for example, that would prevent installation of the floor. Fabricate the floor of 1/16" plywood and install. Complete the installation of controls and then add the tunnel.

The seats, of 1/32" plywood, should be cut to outline shape, soaked in water, and fastened to wood patterns to achieve the proper shape for the back and seat. When dry, glue together, carefully wiping excess glue off the surface. Clear dope or lacquer when completed, and then mount on the floor tunnel.

Cut the instrument panel from 1/16" plastic sheet and cut all openings as indicated. Simulate all instrument-case screws or other fastenings with dots of white glue, and then spray flat black. Use Tatone or similar instruments and bezels.

The cockpit side walls, previously cut to fit into the cockpit, should now be completed. The walls are of 1/32" ply, cut to fit between the formers. Fit with dummy stringers of spruce. Finish with two coats of clear dope.

Construct the throttles, compasses and other side wall mounted details, and mount on the side walls.

Add the fuel transfer pump and fuel line, constructing all parts from plastic stock materials. Color is flat black except for the red grip on the pump handle.

The canopy frame is described under canopy construction.

The head rest is cut from 1/8" plastic foam and covered with very thin dark brown leather or stripped down naugahyde. Simulate the edge welting by gluing on a strip of small diameter, brown insulated wire. Remove the wire from the insulation first. Glue the head rest in place. Cut the center spreader bar of hard balsa and cover with leather as done with the headrest. Add the oil pressure gauges and dummy light and glue the bar in place.

Flying: If you are not an experienced controll line flyer, get someone who is to help you. Don't violate this rule: to do so will jeopardize your many hours of work.

The model is designed to fly without engine or rudder offsets. However, successful take-off and ground operation requires the use of a 10 × 6 inboard prop and a 10 × 5 outboard prop. Do not attempt to fly with identical pitch props. At low-throttle taxi or take-off runs, the model will turn inboard on identical pitch props and cut the flying lines.

Check for proper C.G. location, and epoxy lead sheet into the retraction motor compartment if needed. Do *not* fly in a tail-heavy condition. To do so invites disaster—a crash, particularly if one engine dies.

Run the engines to get the proper idle and shut-off positions cranked-in before any flights are attempted.

Use a Roberts 3-line control handle and make up or purchase a set of 3-52 foot .018" lines. Install stops, of your own improvising, on the Roberts handle to

control travel of the third line indicator on top of the handle. Provide one stop for the full-throttle position. Movement beyond the stop is to actuate the retraction motor DPDT slide switch in the model by virtue of the throttle overtravel arrangement shown on the plans. Provide a second stop at the other end of the indicator travel for the throttle idle position. Movement beyond the stop is to actuate engine cut-off. Both stops should be hinged to swing out of the way of the indicator. One hand can be used to swing the stops out of the way for gear operation and engine shut-off.

With someone to help you, check the operation of all flying lines, stops, throttles, and the DPDT switch and gear retraction without the engines running and *with* the flying lines under tension. Repeat the process with one engine running and then with both running. Make any necessary adjustments on line lengths, handle stops, throttle settings or DPDT switch position. If gear operation fails or is erratic when the engines are running, the problem most likely is intermittent or complete loss of electrical continuity caused by vibration. The vibration or loose connection, or whatever the cause, must be eliminated.

For the first flight, and on *all* flights for testing gear retraction, fly with the nacelles and wheel spats removed. If a wheels-up, belly landing is needed, the model will land undamaged. Otherwise, the nacelles would be wiped out. Some glo-plug damage may be incurred, but this is a minor matter.

Use a little up right aileron to achieve level flight. Use masking tape to hold the aileron in position. Also tape the canopy down as a precaution on all flights. Use a clear tape when in competition.

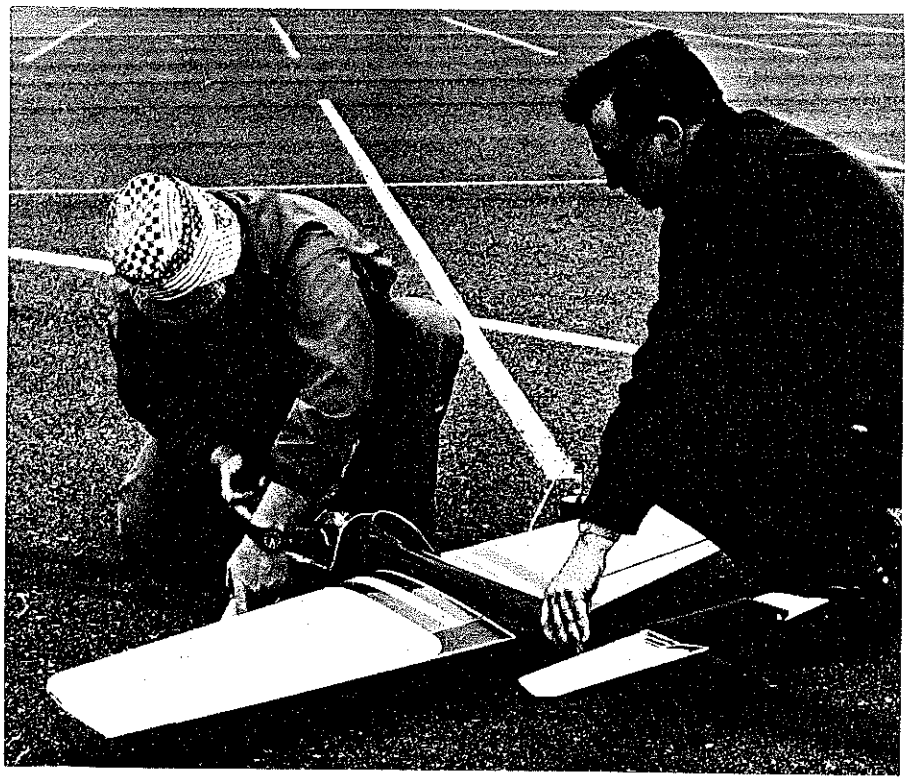
Pick a smooth, even flying surface. This is a must since the model will flip on its nose easily on a rough surface.

Conduct a successful pull-test, and you're ready for the maiden flight. To get the engines running correctly, start the outboard engine and tune to the best rpm by ear or by a reed tachometer. Stop the engine and then repeat the operation on the inboard engine. With it running smoothly, restart the outboard engine. Do any required "tweaking" of the needle valves to be sure engines are synchronized as closely as possible. With a helper holding the plane, reduce the engine rpm (from the control handle) to about the 40% level and release the plane. Hold the plane on the ground, gradually opening the throttle. Don't lift the plane off—let it lift off by virtue of sufficient flying speed. The rest is easy. The plane is fast, but grooves easily. To land, reduce engine rpm slowly, and let the plane speed *decrease*. With the plane flying as slowly as possible, lose altitude slowly and when very close to the ground, reduce the throttle slightly and the model will set down. To reduce the landing roll, or to stop, apply the brake by using full up elevator. Move the third-line control to the engine shut-off position.

Check the aircraft thoroughly after the first flight, and every flight thereafter, for damage, stress cracks, loose nuts, fittings, wheels, engines and control surfaces. With reasonable care, this model is capable of a five to seven year competition life.

The author wishes to extend his appreciation to Bill Harris of Laurel, Md., for his skillful help in preparing the Comet for competition and for acting as "pit" man in many past Nationals.

(Editor's Note: Extensive information—a Scale Information Sheet—accompanies the plans, as does a scale authentication drawing. This information is thus provided for all those who consider entering this model in competition—such information is required for judging, proof of scale, etc.)



Bob Emett holds for Don Schultz. Model is FAI Avenger, OS 35, 47 oz. on a span of 57 in.

CL Aerobatics

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be used by Contest Directors for placing at contests. Flyers will still fly together, but the scoring and awards will be divided into categories. Bob Hunt, N.J., wrote in to state that at the "Flying Goombahs Eastern Controline Championships" in Mass. that the expert and advanced were on one circle and the intermediate and beginners were on another circle.

The chief purpose in this is to provide beginning competition for new flyers and competition for those not in the "top nationals caliber." Let's face it, when a person starts out in a new situation he likes to see some material results of progress. Quite possibly some form of categories for stunt could help to bring this about and attract more flyers to the event.

(My address is: 1640 Maywick Drive, Lexington, Ky. 40504.)