The ALCO Sportplane

A footnote in Aviation history

BY R.G. SCHMITT • PHOTOS BY THE AUTHOR AND FRED D. WOLFE

The year is 1930. Charles Lindbergh had flown the Atlantic just over two years before the world, and America in particular, had come down with a bad case of Aviation fever and many knew the only cure was to "feel the wind beneath their wings." Yet the world was plunging into the deepest Depression ever experienced, and money for flying was scarce indeed. Still, to a few, the desire to fly was so strong that they would find a way to achieve flight, even if they had to create it themselves.

Thus was the real birth of the "home-built" phenomenon. World War I surplus aircraft Jennies and Standards had all but disappeared from the market, and besides, they were too expensive to maintain and operate. But it was possible to build, for very little money if one were clever and handy enough, a small single or two-seater which could be constructed and hangared in a garage, trailed behind the family car to the nearest "flying" field (maybe a pasture?), and soon the harsh world could be left behind.

Such an airplane was the ALCO Sportplane designed by John M. Allison, an aeronautical engineer from the University of Kansas, who, while still a student, taught himself to fly in a home-built of his own design in 1922. After graduation, he became associated with his brother in a firm manufacturing parts and kits for modified war surplus planes, and for home-builts. In his detailed "how-to-build" article in the 1930 *Glider and Flying Manual* (Fawcett Publications), he states that this design would cost only $100 to build, exclusive of engine!

Engines have always been a problem for home-builders, even till today. Many home-builders opted for automotive engines, because of their availability and low cost. Prime examples; B.H. Pietenpol with his Model "T" Ford-powered Sky-Scout and Model "A" Ford-powered Air-Camper (today Volkswagen and Corvair engines are used). Others chose to go the "motorcycle" route, such as Ed Heath (of "Parasol" fame) with his Heath/Henderson conversion. And, of course, the ever-present Harley "74" V-Twin, modified and used by many builders (and available for only $15, used!). Many other builders chose to build their own, starting from readily-available casting kits costing about $35.

There were actually several small (under 50 horsepower) aircraft engines available, such as the Aeronca opposed-twin of 35 hp, the three-cylinder Anzani radial (also rated at 35 hp) and, from England, the opposed-twin Bristol "Cherub" of 32 hp. Unfortunately, the cost of these engines was far beyond the pocketbook of most builders - the cost of the "Cherub," for example, was $1270 in 1928 dollars, when one could buy a new Ford coupe for $600!

The engine which tempted many builders, however, was a small opposed-twin which was Lawrence-designed and built in quantity to power the WW I flightless training plane, the Penguin. These engines were still available in the late '20s and early '30s, new, in-the-box for $100! We pay more than that for a good model engine now. It was rated at 28 hp, but its output was probably more like 24 hp.

The Lawrence C-2 engine, which was chosen to power the ALCO Sportplane, was cheap, light, fairly dependable, easy starting, and easy to maintain. HOWEVER, being a two-cylinder opposed engine with just a single-throw crankshaft, it vibrated beyond belief, and if it didn't shake the airframe apart, it was sure to give the pilot one horrendous headache! Several remedies were available to the home builder; one being a new two-throw crank designed to fit inside the existing crankcase, but which required "bent" connecting rods, as in some two-cylinder outboards. Another remedy, also featuring a new two-throw crank, included a new crankcase which staggered the cylinders, but allowed the use of the standard connecting rods.

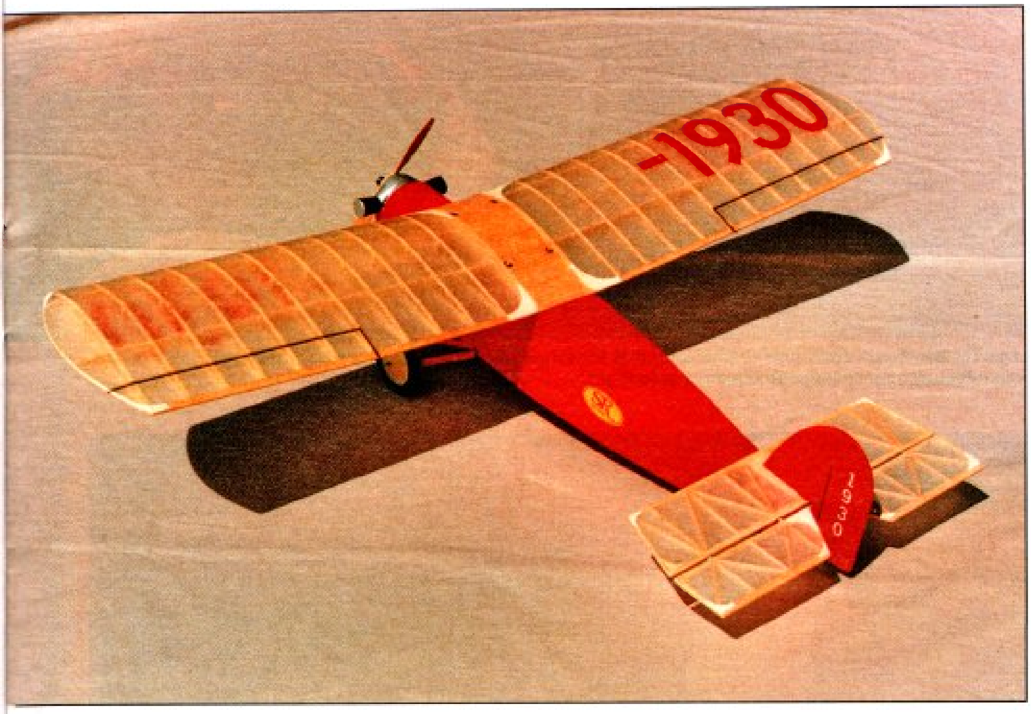
One should not, however, have any vibration problems with our electric powered, 1-1/4" = 1' replica of this interesting lightplane from the Golden Age of American aviation, powered as it is with a 50-watt motor, such as the HiLine "ELF-50." The author has attempted to make this design as accurate a scale model as possible, as regards the airframe, considering the limitations of model materials and construction techniques. Aerodynamic-dictated changes were two in number; four degrees of dihedral was added, as the author's model was built without ailerons, and flown three-channel. If a modeler builds the ALCO with ailerons, the dihedral can be eliminated. Further, the author thinks models still look better with maybe just a trace of dihedral . . . it keeps the wings from looking as though they are drooping!

The model may still be flown three-channel, utilizing ailerons (differentially coupled) and elevators, and no rubber, although the author has not tried this configuration. The prototype was also designed and built with a horizontal stabilizer and elevators approximately 30% larger in area than the scale surfaces. This was done to allow the builder more latitude in the placement of components, and location of final balance point. The scale outline is given on the plan, but if the builder chooses to so build, he should be aware that the final balance must be on the "scale" location.

Construction overall is, in most cases, conventional. The wing is best built by first constructing the spars completely, then building the wing panels one at a time on the spars, and only then completing the center-section. If the builder is using "built-up" ribs, the upper capstrips must be cut from 3/32-inch quarter-grained medium sheet, 3/32-inch wide. The lower caps may be cut from 3/32-inch square medium strip.

To begin construction, the leading and trailing edges are first pinned down to the plan, then the lower capstrips are fitted and glued in place. The spars are then positioned and glued, and the simulated "compression spars" and "drag and anti-drag" rigging, which is made from 1/32-inch round bamboo, doped silver, to represent the cables of the full-scale original (a good source for 1/32-inch bamboo is your local establishment that serves Mai-Tais). The wingtips are also bamboo, 1/16-inch round, to represent the 1/2-inch diameter steel tubing of the actual aircraft (these can be obtained at your local grocery store, sold for kabobs, etc.).

It is recommended that the tips be completely formed with heat (soldering iron,



heat gun, electric kitchen range, even a turned on electric light bulb) before gluing in place (a scrap plywood form may assist in getting the correct shape). The upper capstrips may then be fitted, noting that at the trailing edge, they lay along side the lower caps (this gives a much stronger trailing edge joint). To complete the panel while it is still pinned down, add the upright braces between the upper and lower caps. Note that the root ribs are not installed at this time.

If the builder selects not to use the built-up rib construction, but opts for the solid ribs, the construction sequence is somewhat different. The spars are first positioned on the plan, then the ribs are glued in place, next the leading and trailing edges, and finally the bamboo tip. It is not practical to try to cut openings in the solid ribs to fit the "drag and anti-drag" simulated rigging, but it is advisable to use the mid-span "compression" struts to reinforce the 3/32x3/8-inch ply strut pads, which are fitted between the two indicated ribs, and butted up to the spars.

The second panel is completed in the same manner as the first, and then the center-section ribs are glued in place on the spars. If the builder is using "solid" ribs, it will be necessary to modify the root ribs, as the spars are flush with the lower surface of the wing, as must the pre-drilled plywood wing holddown pads, the spar cannot set on the pad as it will with the built-up rib construction. Instead, the pads are notched into the ribs as shown, but will be butted to the spars. Also, with the solid rib construction, cut the spar notches in the root ribs only as deep as necessary to accommodate the spars.

The center-section can then be completed with the addition of the leading and trailing edges, and the upper and lower 1/32-inch sheet skins. If the builder has not pre-shaped the leading and trailing edges prior to assembly, the next step would be to shape the airfoil section completely (the author uses a

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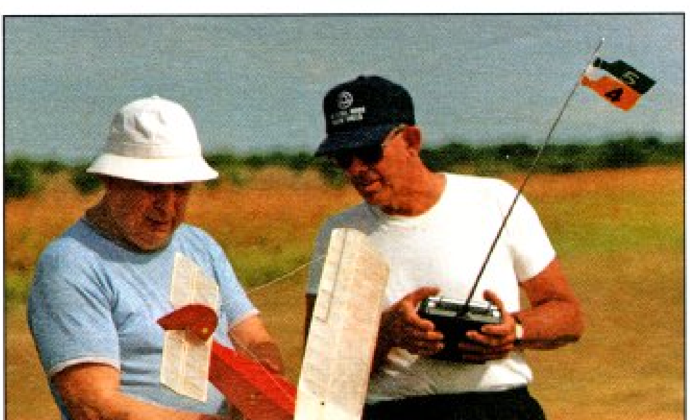
(Left) Two views of the completed model. Note the scale structure, the ideal proportions, and the simple lines. As a contemporary is reported to have remarked, "It's nothing but a BIG model." (Below left) Test pilot Phil Oestricher and the author discuss control surface response (see text). (Below right) A fly-by . . . if you listen carefully, you can almost hear the irregular exhaust "bark" of the Lawrence "two-banger."



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razor plane on the leading edge, and a sandpaper block on the trailing edge), and then lightly sand the completed structure all over. The center-section and wingtip gussets are then added, and faired into the structure (sanded). These gussets not only contribute to the strength of the wing, but also prevent unsightly wrinkles from forming in the corners of the covering when shrunk. The completed wing structure should then be sprayed with two thin (50-50) coats of clear dope (can be tinted if the builder wishes to duplicate the spruce structure of the original), sanded lightly again all over, and set aide.

As the outline of the vertical stabilizer and rudder is of laminated construction, the initial step is the fabrication of the required form. Trace (or duplicate) the plan form onto a sheet of paper, and contact cement it to a piece of scrap 1/8-inch sheet. Cut out to the inner outline, sand, and brush the edge with melted parafin (or rub with a candle). The actual outline is four laminations of 1/8x1/32-inch strip, which have been soaked in vinegar for several hours, then wrapped around the form, and held in place with strips of drafting tape till dry. When dry, the laminations can easily be bonded together with thin CA while still on the form.

After the CA has set up, the outline is transferred to the building board, and the internal structure added. The builder is given the choice of using the scale hinge-line (indicated on plan), or a second line, a 1/2-inch further aft. The aft hinge line is recommended, as the model is very sensitive to rudder inputs, and, unless one has a dual-rate transmitter, it is very easy to over-control the model. While still flat on the plan, remove the building pins, and block sand. Remove from plan, turn over, and repeat. Round the leading edge and tip, but leave the trailing edge square. Give the assembly two coats of thinned dope, sand again, and set aside. Leave the fin and rudder joined until you are ready to install the hinges.

Unless the builder is constructing a competition scale model, it is advisable to build a somewhat larger fin and rudder, as the model is almost "directionally neutrally stable" in scale. A larger vertical surface makes the model considerably easier to fly.

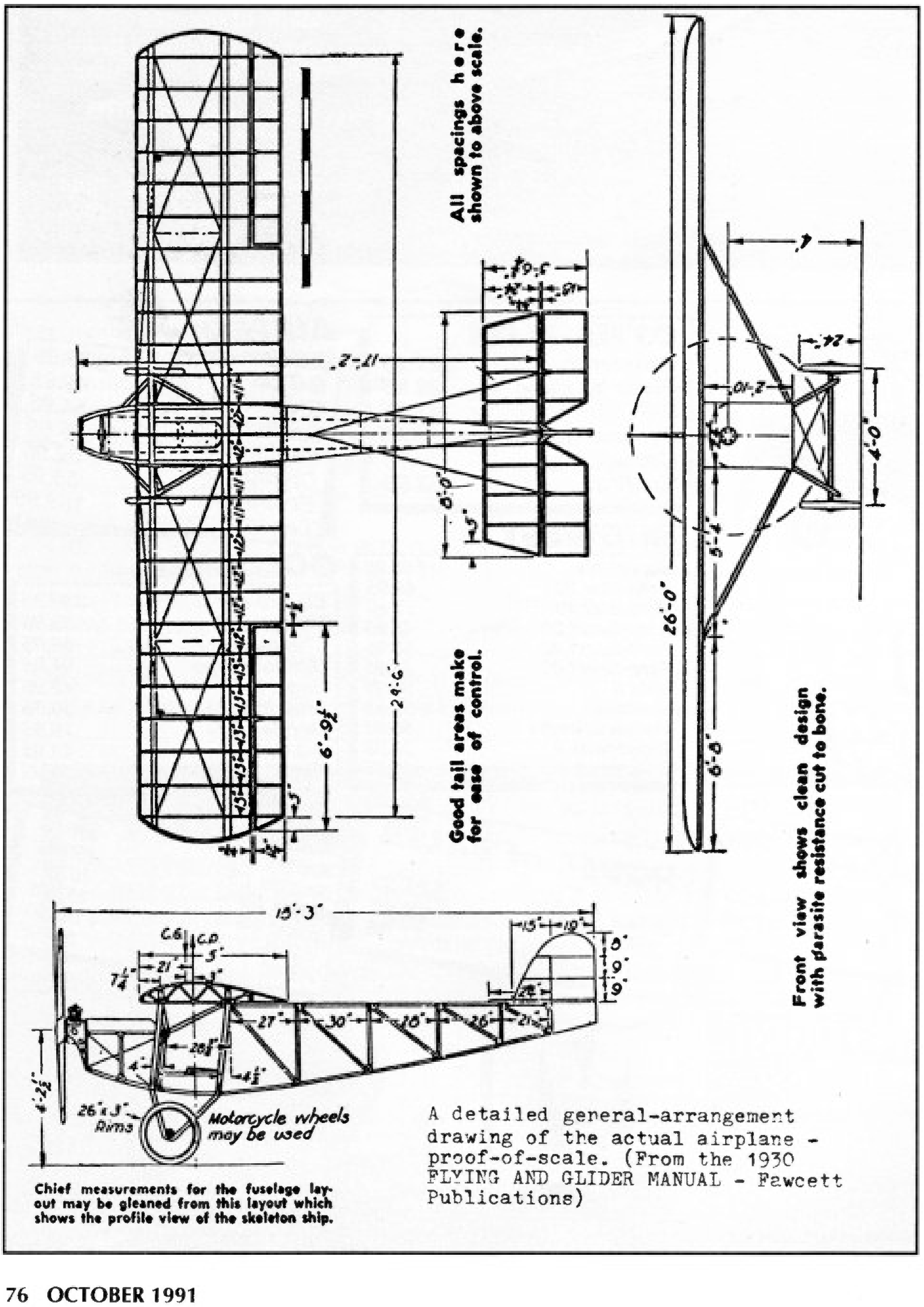
The horizontal stabilizer and elevator are built flat on the plan. Spars should be cut from hard or very firm 1/8-inch sheet. Taper as indicated. Note that the center of the elevator spar is a piece of 1/8-inch dowel, shaped as shown, and firmly cemented to the elevator spar halves. Install the tips (1/8-inch square) and ribs (1/16x1/8-inch), let dry, and block sand each side. Again, round the leading edge and tips, but leave the trailing edge square. Accurately bend the .032 MW stiffener, and cement in place with CA. Dope, sand all over, and set aside.

FUSELAGE

Begin fuselage construction by cutting out the "firewall" and the "cabin bulkhead" from 1/8-inch plywood. Select hard 1/8-inch square for the longerons, and medium 1/8-inch square or 1/16x1/8-inch for the uprights, crosspieces, and diagonals as indicated on the plan, except the forward cabin uprights, which should be of spruce for greater strength. Because of the sharp curve of the lower longerons, it is highly recommended that they be pre-bent before assembly. The author soaked the first 12 inches of the longerons in vinegar (in a deep, narrow flower vase) for about three hours, then taped them to a pre-cut form of 1/4-inch plywood until dry (Soaking in boiling water, or steaming, also will allow a curve to be set in the longerons).

Note that the fuselage sides are not symmetrical in the "cabin" area, but the builder may still build one side over the other, if this is kept in mind. Accurately mark the location of, but do not install the "cabin" bulkhead at this time.

Remove the fuselage sides from the plan, and separate. Set sides on the upper longerons, align them at the rearmost upright, bind with a rubber band, and place cabin bulkhead in marked location (do not cement yet). Carefully draw front of fuselage together, inserting "firewall" in correct position, and bind with rubber bands. Do not cement. Check alignment, glue cabin bulkhead in place. Carefully insert and cement cabin area cross members in place, including the 1/8x3/8-inch ply cross pieces (wing attachment) which are undrilled at this point, making sure that the structure remains square and true. Hold with rubber bands and temporary diagonals if necessary. When set, add "instrument panel" and forward cross members, and "firewall." Be sure that the longerons bend uniformly; assist with steam or vinegar if necessary. Then, starting at the bulkhead, work station-by-station towards the tail-post, inserting cross pieces and diagonals as you progress, always being conscious of the structural alignment, particularly in twist. Add floorboard, and all gussets not previously installed. Even though they



Chief measurements for the fuselage layout may be gleaned from this layout which shows the profile view of the skeleton ship.

A detailed general-arrangement drawing of the actual airplane - proof-of-scale. (From the 1930 FLYING AND GLIDER MANUAL - Fawcett Publications) can't be seen after the fuselage is covered, to carry through the scale structure, install the firewall "cable" reinforcement (1/32-inch bamboo, doped silver).

At this stage of construction, it is necessary to decide the internal equipment arrangement. The plans show the arrangement used by the author in his original model; the rudder servo mounted high so that the rudder "cables" would be in line with the scale location of the rudder horn. This shelf also provided a good location for the receiver battery. All other equipment is mounted on the floorboard as illustrated. It is also advisable at this time to determine the direction of rotation of your elevator servo, so that it may be positioned with the output shaft either pointing right or left, so that the elevator horn can be on the bottom side of the elevator, and the pushrod isn't required to go up through the horizontal stabilizer (see drawing). The elevator horn may be positioned either on the right or left as necessary.

After the internal arrangement is settled, draw in on the plan the route of your control cables/pushrods, to determine the location of the fairleads. The author used 1/16-inch ID plastic tubing, held in place with CA, and, of course, the covering.

Carrying the scale structure concept further, the author's model was covered back from the firewall to the cabin bulkhead with 1/64-inch plywood, to represent the 1/8-inch plywood sheathing of the full-scale airplane (It sure makes a rugged nose). To cover the upper cowl more easily, make a pattern of the exact shape required with paper, transfer it to the plywood, cut out, and immerse in boiling water for 15 minutes. Remove from the water, and bind to a two-inch diameter form (the author used a juice glass) with bandage, and dry in an oven at 250 degrees. Also, thin aluminum (a litho plate) could be used. Cement (or bond) in place.

Sand the fuselage structure well all over, removing any protrusions which will interfere with a smooth covering job. Make a small drill jig from scrap plywood, which will accurately locate the four small holes in the lower side of the fuselage. Use as a reference plane the lower edge of the fuselage, and key to the cabin bulkhead. The two outer holes are 3/32-inch diameter, and are for the landing gear support tubes, and the two inner holes are for the wing strut positioning grommets. They are drilled 1/16-inch diameter. After the holes are drilled in both sides, insert the landing gear support tubes, which are 1/16-inch ID aluminum tubing, 2-5/8 inches long. When inserted through the fuselage, they barely protrude on each side. They must be well cemented into both the skin, and the structure, and to accomplish this, it is recommended that "thin" CA be used liberally, both inside the fuselage and where the tubing comes through the ply skin. If you can't locate any small flanged grommets, short (1/4-inch) lengths of 1/16-inch ID tubing may be used, CA in place. The tailskid may also be installed at this time, cemented to the 1/8-inch sheet "fill" at the station indicated.

To complete the wing mounting provisions, temporarily position the wing in the correct position, making certain it is centered, and at exactly 90 degrees to the longitudinal axis of the fuselage. This can be determined by measuring from the tailpost to each wingtip (these measurements must be identical, with the wing correctly positioned and centered). Then, using a sharpened pencil, accurately locate the position of the wing hold down bolts in the plywood fuselage cross-members (four places) from the existing holes in the wing center section. Drill four holes, 5/32-inch diameter, and insert from underside of crossmember, a 4-40 "blind" nut in each hole. Cement in place with CA, being careful not to get any into the threads.

The completed fuselage structure should then be sanded all over, given two thin coats of dope, sanded lightly, and set aside.

The landing gear halves are bent as shown using the drawing as a pattern; bend the lower "V" first, leaving about 1/2-inch of wire on each "leg." Note carefully that this extra wire is in the plane of the "V" and each is parallel to the other (to confirm this, attempt to insert each "V" in the landing gear support tubes in the fuselage without forcing). Then, and only then, make the final bend in each "leg" to set each "V" at the correct angle to the fuselage. The axle/ spreader bar is bound to each "V" with soft iron wire and soldered, but not until final assembly. Also, because of the heat involved in soldering, the "fairing" is not installed until after the soldering is complete.

The wing struts are very simple 3/32 x5/16-inch hard balsa or basswood, sanded oval, slit on one end to accept a small piece of "flex" hinge material, the other end grooved to accept a 3/4-inch long piece of 1/16-inch OD plastic insulation, from which the wire has been stripped. The horizontal stabilizer strut is merely a short piece of 1/16x1/8-inch bass, sanded oval.

It is recommended that a trial assembly be made at this point, to be sure that all the components fit properly, and that the wing and tail surfaces are aligned correctly. The wing may be attached with the four 4-40 nylon screws, and the tail surfaces "tacked" in place. Fit the wing struts . . . they are held to the wing with a No. 2, 1/4-inch wood screw. Be sure to leave at least 1/8-inch between the side of the fuselage and the end of the strut, so in case of impact, the plastic will bend, and slip out of the grommet, thus saving the strut.

This is also the opportune time to fabricate the elevator push-rod. Bend a 1/16x 1/16-inch "Z" in one of a length of .032 MW. Engage the top innermost hole of your servo output arm (or disc), feed the end of the wire through the fairlead, and position the servo in its proper location. Hold with servo tape. Measure from the end of the fairlead to the elevator hinge line. Make a 90-degree bend in the wire at this point, and then, cut the push-rod in two, approximately two inches from the end of the fairlead. Remove the servo and push-rod from the airframe. On the cut off end, complete the "Z" bend, and trim to length. Set aside.

The model may then be disassembled, and lightly sanded all over in preparation for covering. The choice of covering material is up to the builder, but it is most highly recommended that very serious consideration be given to the covering weight. The author used Silkspan, but Micafilm and silk (if one doesn't get too enthusiastic about filling the weave of the silk, and getting a high gloss finish) are both reasonable substitutes. Most plastic films are too heavy. After covering and doping (if required), the control surfaces should be hinged with "flex" hinge material such as that made by "Radio South," cut into strips 1/8-inch wide by 1/2-inch long. To use, one merely makes a cut about 1/4-inch deep in the surfaces to be joined, inserts the strip into each surface, and puts a drop of CA into the joint. the paper covering on the polypropylene draws the CA into hinged surfaces by capillary action, and there the hinge stays. It is best to flex the hinge a number of cycles, before installing the surface on the airframe. The control horns should also be installed now.

PHOTO OF PROTOTYPE

The author has only been able to locate one actual photograph of a full-scale ALCO, probably the prototype. It was probably taken with orthographic (colorblind) film, and shows an airplane with very light (translucent?) wings and stabilizer, and a darker fuselage and fin (also wire wheels . . . motorcycle?) Based on this photo, the author's model was finished with clear-doped white Silkspan wing and stabilizer, and a red fuselage and wheel discs. Floquil model train enamel pigment was used for coloring, by permitting the pigment to settle in the bottom of the bottle, then drawing off the liquid above, and refilling the bottle with butyrate (or nitrate) thinner. Shake well, and add to an equal quantity of clear dope, and thin as desired for brushing or spraying. Two thin coats give a very "solid" color without much weight. The photograph showed an airplane completely devoid of markings, but the author added a spurious registration number ("-1930") in tribute to the time and pilots who flew these home-builts.

The "dummy" Lawrence C-2 which adorns the front of our model also serves as the motor mount, the construction being clearly illustrated on the drawing. The "crankcase" consists of a mounting ring (1/4-inch balsa), and a "crankcase" (1/2-inch balsa) cemented together, and epoxied to the firewall. Before installation, however, the downthrust shim, the sidethrust shim, and the motor mount should all be cut from plywood as shown on the plan, stacked together on the crankcase, and the two mounting screw holes (7/64-inch) then drilled in position, thus assuring alignment. The holes in the crankcase are enlarged to 5/32-inch, and a 4-40 blind nut CAed in each hole on the rear face, after which it may be installed on the firewall. The two dummy motor mounts are cut from 3/32-inch plywood, and are also epoxied to the firewall as indicated.

To replicate the cylinders on our little engine, one can spend as much or as little time as wished, from store-bought Williams Brothers cylinders, to stacked card and balsa discs complete with push-rods and rocker arms (no, it did not have rocker box covers). To make the cylinders on his model, the author used two 3/4-inch diameter corks, cut off to 3/4-inch long, and drilled 1/8-inch down through the center. The corks are then slipped on a short piece of 1/8-inch dowel, chucked up in a handi-grinder (or drill), and grooves cut every 1/16-inch, 1/8-inch deep with a razor saw blade, then cemented in place. The entire dummy engine is then given two coats of sanding sealer, sanded, and given two coats of aluminum dope. The cylinders are then colored dull black, and the motor mounts colored to match the fuselage.

The model is now ready for final assembly. Complete the landing gear by inserting both sides into the support tubes, bind and solder the spreader bar/axle in place, and

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add the fairing strips. Cover with silk, and dope to match the fuselage. Install the wheels, and retain with a washer soldered in place. Install the tail surfaces, being certain that the horizontal stabilizer is exactly parallel to the wing mount. Shim if necessary. Add the stabilizer support struts as indicated. The fin and rudder are installed next, exactly perpendicular to the stabilizer.

The next operations are installation of the radio gear receiver, servos, and switch, which will vary with each individual installation. When the elevator servo is installed with the partial pushrod installed, it may be joined to the aft portion (which has been engaged to the elevator horn) by means of a short piece of 1/32-inch ID brass tubing, coupling both pieces, and soldered in place when the servo is set to neutral, and the elevator at zero angle.

If the builder has chosen to duplicate the rudder "cables" of the author's model, a few hints may be helpful. First, bend two small "S" hooks from .032 MW. Cut two lengths of dial cord (or 10# fish line) about 30 inches long. Holding the fuselage vertical, drop one end of each length down through the fairlead, into the "cabin" area. Retrieve, and tie an "S" hook to each "cable." Secure with a drop of CA. Insert "S" hooks into the innermost holes in your servo output arms. Slip a short length (1/2-inch) of 1/16-inch ID plastic tubing over each line, then insert through hole in rudder horn, then, back through the plastic tubing. With the fuselage still vertical, attach small equal weights (four to six ounces) to the ends of the lines (the author used machine washers). Adjust rudder until it is perfectly aligned, then slip the tubing up to within 1/2-inch of the control horn. With the weights still applying tension, put several drops of CA into the tubing. When set, cut off the extra line (and weights), and dope the tubing "bronze" (to represent a turnbuckle).

Install elevator pushrod as described above. If the builder is creating a real scale model, it might be worth the extra scale points (and effort) to make the elevators cable controlled also.

The final steps are the installation of the propulsion system and final trimming. The motor is, of course, attached to the motor mount with the screws provided (they are metric) so don't lose them! Be sure the openings in the motor mount are clear, and do not restrict the cooling air into the motor in any way. Note also that sandwiched between the motor mount and the engine are the "sidethrust" shim, and the "downthrust" shim. They have been made separate, so that adjustments may be made to one without affecting the other. Use the position of the flight batteries to determine the position of the assembled model's balance point. Be certain it is within the limits shown on the plan, preferably towards the forward location. If necessary, the receiver battery may also be used to help locate the balance point as desired.

The sidethrust shim may be shaped as shown, to give approximately two degrees of right thrust. If less is required, the shim may be reshaped with a sanding block to give just the correct amount, so that rudder trim changes are not necessary between power on and power off flight. If more side thrust is required, the shim may be sanded to a knife edge, and if that is not sufficient, the flyer has no alternative but to make another shim of 1/8-inch ply. The author's model required 2.3 degrees.

Before discussing the "downthrust" shim, the author must tell you of the initial test flights of the "ALCO." To say it flew "off the drawing board" would be putting Baron Munchausen to shame. As you probably have noticed, there is already two degrees of downthrust built into the firewall. The author assumed that this would be adequate for the first flights (how wrong can you get?). Although the model glided well with no trim required, the first powered flight was nearly disastrous. The model, hand launched, immediately went into a steep climb, which got steeper as the speed increased. More and more down stick and down trim were put in as fast as the fingers would move, but the climb became more and more vertical until finally the motor quit (the model was equipped with a Benson "Bump" motor controller, which turns the motor off on a full down elevator signal). The model came right straight down . . . fortunately in tall grass. The damage was minimal and the model was ready to fly the next day, only this time with four degrees of downthrust!

Second verse, the same as the first. Next day, with six degrees, the model was flyable, with full down trim, and some down stick held in. Next day, with eight degrees built in, the model only required two notches of down trim, and flew as shown in the pictures. To completely eliminate the need for down trim, it does require somewhere between eight and ten degrees of downthrust . . . the final amount is to be determined by the builder . . . so be aware start out with at least eight degrees! ***MB***

For your reference - here are the weights of the original model: