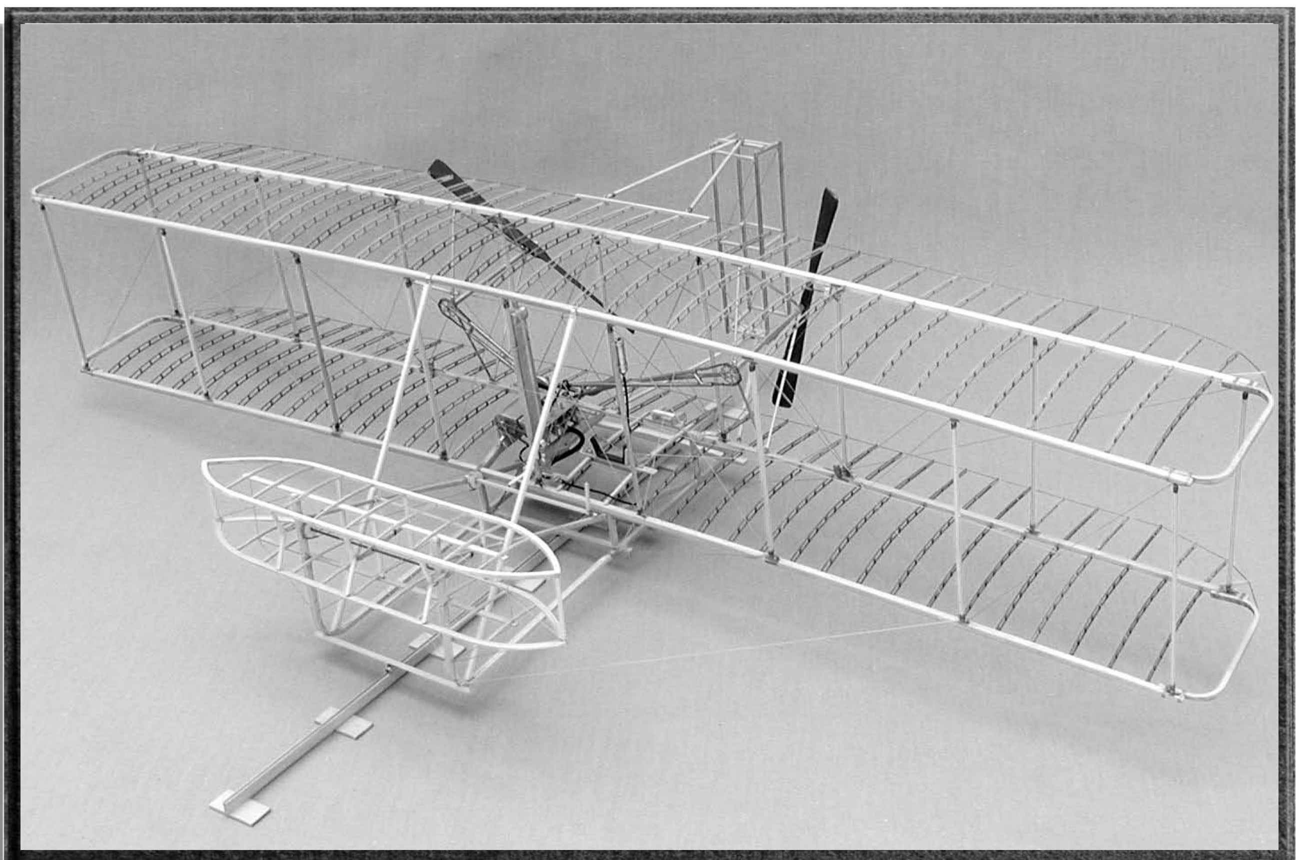
INSTRUCTION MANUAL

THE FIRST AIRPLANE
THE WRIGHT FLYER
✦ 1903 ✦

INSTRUCTION MANUAL PREPARED BY
DR. DAVID G. ULLMAN AND KENNETH H. GOLDMAN 2003

Technical Characteristics
SCALE: 1:16
WINGSPAN: 30-1/4" (768 mm)
LENGTH: 15" (382 mm)



MODEL AIRWAYS

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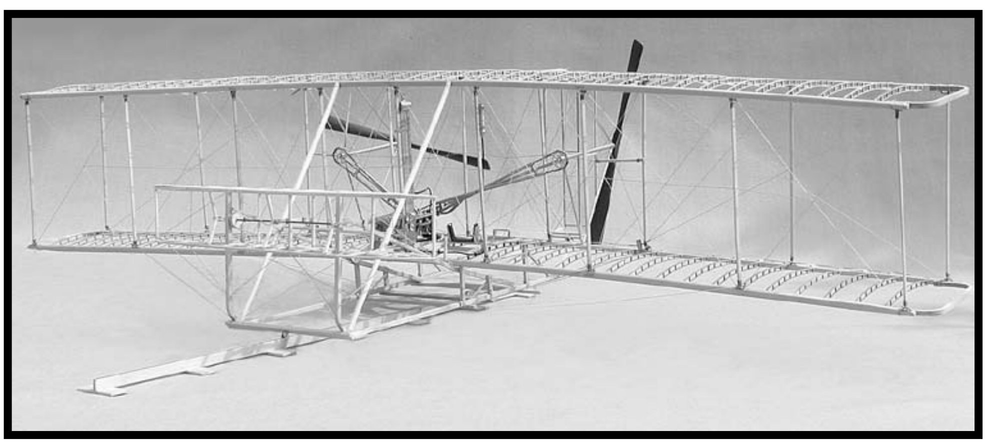
Model Airways Kit No. MA1020

On December 17 1903 at 10:35 a.m. Orville Wright accomplished the first manned, controlled, powered flight in the airplane that is now known as the "Wright Flyer." The flight lasted about 12 seconds and the plane traveled an estimated 120 feet. Later that day at Kitty Hawk North Carolina, on the forth flight; Wilbur flew 852 feet in 59 sec. During celebrations after the forth flight the wind turned the Flyer over and it never flew again.

These flights were the result of four years of one of the greatest engineering feats of all time. The brothers used their free time from the bicycle business to study flight and systematically develop the Flyer. By 1903 they had greatly improved the understanding of how wings produce lift, made the first systematic study of how to control an airplane and had designed the first practical propeller. Additionally, they had designed and built an engine powerful enough, yet light enough to be used in an airplane.

The Flyer had a wingspan of 12.3m (40' 4") and a length of 6.1m (20' 1") and weighed 625lb (283 kg) with pilot. It was powered by an engine designed by the Wright Brothers and their machinist assistant Charlie Taylor. The engine produced 16 hp (12 watts) and weighed 150lbs (68 kg). The pilot controlled the elevator with his left hand, the fuel flow to the engine with his right, and executed turns by moving his hips left and right.

The flyer is now on permanent display in the entrance lobby of the Smithsonian National Air and Space Museum in Washington D.C.



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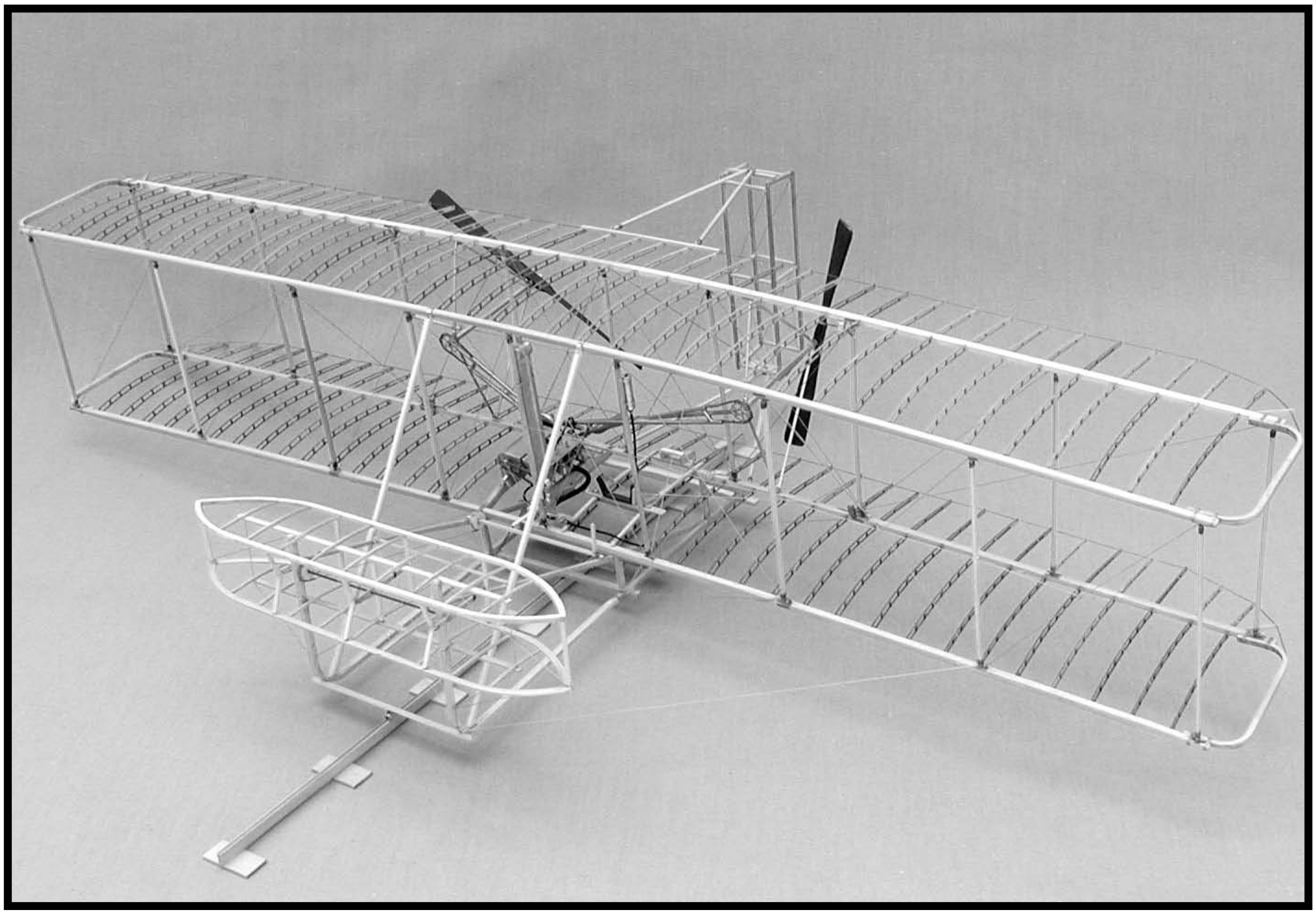
MODELING THE
THE WRIGHT FLYER
✦ 1903 ✦



PLANS AND INSTRUCTIONS BY
DR. DAVID G. ULLMAN AND KENNETH H. GOLDMAN
PROTOTYPE MODEL
BY BOB WERNER, HOLLYWOOD, FL

Before You Begin

The Flyer is a very interesting aircraft and makes a splendid model. The kit is intended as a structural model without covering. Nearly every detail of the real aircraft has been included as scale permits.

The kit is supplied with Britainia metal castings, photoetched brass parts and laser-cut wooden parts, making the kit unique and easy to assemble. The metal castings are of excellent quality, and will require some final finishing before they can be assembled.

If you are a beginner, take your time. This model is detailed and has small parts. Make sure you complete one stage before moving to the next. Don't worry about repeating a step.

Working with the Plans & Parts

Before starting construction on your model, examine the kit and study the plans and figures carefully. Familiarizing yourself with the kit will help you determine that all parts have been supplied as listed. You'll also be surprised at just how quickly handling the parts allows you to better understand the kit and the way the Wright Brothers designed the first airplane. Try to visualize how every part will look on the completed model.

In order to locate small fittings and hardware, and to prevent loss or damage to these parts, it is highly recommended that parts be kept in appropriately marked storage bags/boxes until they are used.

Plans

3 Plan Sheets are provided:

Plan Sheet 1

Top Wing Layout

Bottom Wing Layout

Plan Sheet 2

Wing Warping Cradle

Wing Strut

Warping Cables

Plan Sheet 3

Landing Skid

Elevator Control Frame

Elevator & Actuation System

Rudder

Launching Dolly

In addition, a set of sketches appears throughout this instruction manual to further illustrate the various stages of construction.

The WRIGHT FLYER kit is manufactured to a scale of 1:16. Each plan sheet is drawn to the exact scale that the model is to be built, except for some sketches which have been enlarged for clarity. Where necessary, dimensions can be lifted directly off the plans by using a set of draftsman dividers or by using a "tick" strip, which is simply a piece of paper used to "pick-up" the dimensions . Lay your paper strip over the plan and mark the lengths of items carefully with a sharp pencil. Then use the strip to transfer the marks to the wood or item to be made to scale.

Part dimensions on plans and in the instructions are given in millimeters and equivalent inches. It would be a good idea to have a small plastic or wooden scale marked in inches and millimeters so you can measure and identify the parts provided.

Parts

Note that all part numbers that are identified by WF-LXX are laser cut wood parts. All designated WF-PEXX are photoetched and all with WP-BXX are Britania metal.

All parts: castings, rod, wire, tubing, sheet stock, laser-cut wood, wood strips, and rigging line are designated by a letter-number (such as WF-L18) on plans and sketches. A parts list is included in each of the construction stages, noting the parts required for that particular stage. A master packaging parts list (separate from these instructions) is provided, listing the quantities included in the kit. For wood strips, sheets, rod, wire, tubing, and rigging, one or several pieces are provided in the kit as noted on the master packaging parts list. Each of these have been assigned a Model Expo stock part number. These parts must be cut to length or shaped according to plan dimensions.

For identification, laser-cut wood part patterns are illustrated in Appendix A. Sketches of the various britannia metal castings are shown in Appendix B. Sketches of photoetched metal parts are pictured in Appendix C.

Wood

Your kit contains basswood (or Limewood) wooden parts.

It is a good idea to sort the stripwood contained in the kit by size. When building a certain part, select a suitable size and after cutting what you need return it.

When removing laser cut parts wipe all edges with a tissue to remove the carbon residue. This will be light on solid wood parts, but may be heavy on plywood. You may want to sand edges to remove any discoloration.

Cast Metal Fittings

The kit is supplied with large amounts of britannia metal castings. The britannia fittings provided may require some final finishing before they are suitable for installing on the model. Clean them up by removing any mold-joint flash. To do this, use a No. 11 hobby blade to cut the flash, then file or sand with fine sandpaper. It is also suggested that you clean the fittings thoroughly with warm, soapy water.

Photoetched Parts

This kit has two sheets of brass, photoetched parts. Remove the parts with needle nosed pliers by gently twisting them back and forth. Use a file to clean any flash that might remain.

What You Will Need

The following tools and supplies are recommended for the construction process. Modelers who have built before may have their own favorites.

A. Knives and saws
1. Hobby knife
2. No.11 blades
3. Razor saw or jeweler's saw

B. Files
Set of needle files

C. Clamps and Pins
1. Alligator clips (supplied)
2. Wooden clothespins (craft shops have small versions of the design)
3. Rubber bands
4. Package of straight pins

D. Boring Tools
1. Set of miniature drills
2. Pin vise

E. Miscellaneous
1. Tack hammer
2. Tweezers (a few)
3. Small fine pointed scissors
4. Miniature pliers
   a. small round
   b. flat nose
5. Wire cutters (for cutting fine wire and strip metal)

F. Sandpaper
Fine and medium grit garnet or aluminum oxide sandpaper (#100 to #220), and #400 wet-or-dry paper for fittings and final wood sanding.

G. Glue
White glue, Carpenter's wood glue (yellow in color), and Cyanoacrylate glue(super glue) can be used for most of the model. Five-minute epoxy provides extra strength for gluing fittings. Cyanoacrylate (super glue) is best for wood-wood joints. Only use epoxy for metal-metal or metal-wood joints. Roughen metal surface with sand paper for best adhesion.

H. Building Board
A soft, but stiff board such as acoustic ceiling tile or insulation wallboard to easily take straight pins for holding parts during assembly. This soft board should be nailed or glued to a hard board so it will be flat. Of course, you can use a table, but a portable board is convenient for turning it around

as necessary to make the work easier.

Painting and Staining

The Flyer model need not be painted or finished at all. However, it is recommended that you stain or seal the wood parts and seal the Britiannia castings for protection. A clear or light tan finish on the wood is best.

There are many brass parts in this kit. They can be left plain or painted black or dark gray for contrast with the wood structure. Before painting the brass parts, sand them lightly with fine sand paper.

Engine parts can be painted with a gray wash and highlighted for contrast.

Sanding and Cleaning

Sand all wood surfaces with 220-grit dry sandpaper, followed by 400-grit, and wipe off all dust thoroughly. A tack rag is helpful here.

Brushing and Stains

A soft artist quality brush can be used to apply stain to the parts. Floquil stains or Minwax brand stains are excellent for staining. For the castings, Floquil clear flat finish is ideal.Brushing and stains: A soft artist quality brush can be used to apply stain to the parts. Floquil stains or Minwax brand stains are excellent for staining. For the castings, Floquil clear flat finish is ideal.

This finish could also be applied over the stained wood parts as added protection.

Painting

If parts are to be painted, use a primer first, then paint. Floquil, or any of the model paints are satisfactory. For this model, flat paints will probably look better than gloss paints.

SCALE CONVERSION TABLE

Full Size Inches	Model Scale Inches	Model Scale Millimeters
1/4"	1/64"	0.40mm
1/2"	1/32"	0.79mm
3/4"	3/64"	1.19mm
1"	1/16"	1.59mm
1-1/4"	5/64"	1.98mm
1-1/2"	3/32"	2.38mm
1-3/4"	7/64"	2.78mm
2"	1/8"	3.17mm
2-1/4"	9/64"	3.57mm
2-1/2"	5/32"	3.97mm
2-3/4"	11/64"	4.37mm
3"	3/16"	4.76mm
6"	3/8"	9.53mm
9"	9/16"	14.29mm
12"	3/4"	19.05mm

STAGE 1: BUILDING THE WINGS

The wings on the Wright Flyer were much larger than had ever been used on a flying machine before. The Wright Brothers calculated the size based on their experiments with gliders, 1899-1902. The airfoil shape is one they developed during their wind tunnel experiments during the winter of 1901-1902. The wings were very light for their size. They weighed less than 45 kg (100 lbs) each and were 2 x 12 meters (6.5 x 40') in size. As will be appreciated, the structure is delicate. In fact, after the 4th flight of December 17, the wind picked up the Flyer turned it over and seriously damaged the craft.

With the exception of ribs near their centers, the top and bottom wings are identical. These instructions will begin with the top wing and then only detail what is different with the bottom one.

The Wright Flyer model is built by first constructing each of the wings on the Wing Building Jig. In Stage 3 the bottom wing is then strapped into the Wing Assembly Jig that holds it for installing the engine, drive train, landing skid and top wing.

Wing Building jig

Assemble the wing building jig as shown on Figure 1. The location of the formers, WF-L07, is shown on the Plan 1. The stringers are made by splicing two pieces of 1.5 x 6.5 mm (1/16" x 1/4") wood strip together to make 3 stringers 775 mm 30.5" long. This jig will be disposed of after building the wings, so the style of the splice is not important.

Wing ribs

Carefully remove wing ribs and tips WF-L01 to WF-L05 from sheets and sand off any discoloration due to laser cutting with fine sandpaper attached to a flat block. For cleanest removal of parts from the sheet, cut tabs connecting ribs with light pressure from one side of the sheet, then turn the sheet over, and cut from second side. Sand any remaining flash from the ribs. Be sure when installing the ribs that the thicker end is toward the front. The rib should be flush top and bottom with the leading edge spar and main spar. Note that extra wing ribs have been supplied in case any are damaged during building the model.

The top wing

Sort leading edge and main spar material 3x4mm (1/8" x 5/32") so that any natural warp in the material causes the tips to bow down. The spars are identical on both wings and so the spars can be made all at once. Note that the main spars are wider than they are tall and the leading edge is taller than it is wide.

Using full-size top wing layout, Plan 1, make the three sections of the leading edge spar and the main spar with a butt joint as shown on plan and in Figure 2. Do not glue them together yet. The Wright Brothers used the same three-section spar. Trim the spars to length and round the leading edge spar top

PLAN 1 TOP WING LAYOUT

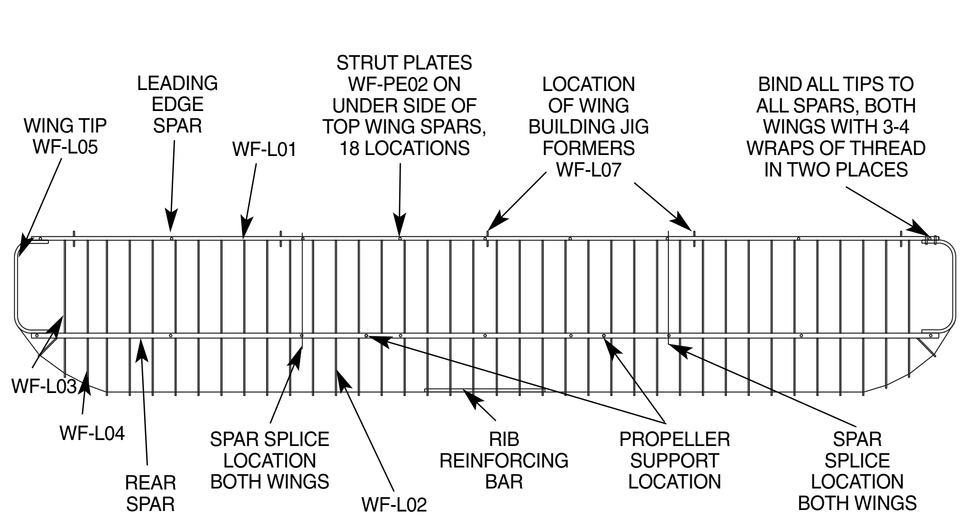


FIG. 1 WING BUILDING JIG

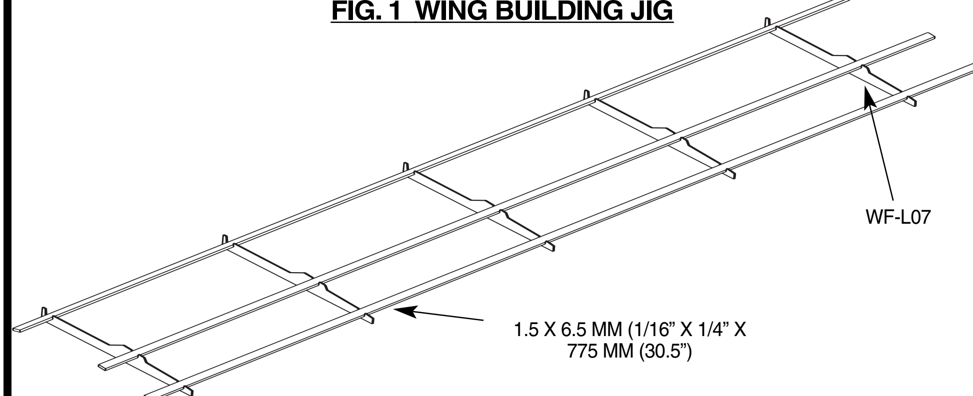
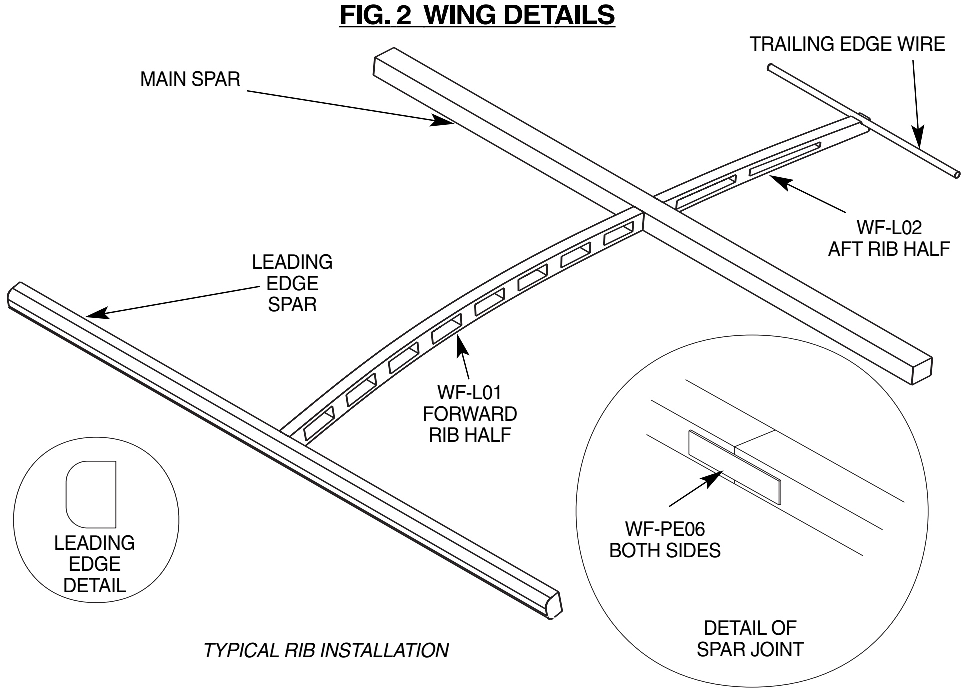


FIG. 2 WING DETAILS



and bottom edges as shown in Figure 2. Carefully taper the leading edge spar from last rib to the tip at both ends. The taper should be the same on both top and bottom of the spar and tip thickness should match the thickness of the laser cut wing tip 3mm (1/8”). The main spar needs no taper.

Drill holes in 2 places on the bottom of the main spar as shown on Plan 1 for the propeller support assembly WF-B30. The holes should be 1m (3/64”) dia. and at least 2mm (.08”) deep but not all the way through the spar. They should be 195.5mm (7.7”) apart. A matching hole needs to be drilled on the topside of the main spar for the bottom wing.

Glue the spar sections together and brace each joint with the hinge plates, WF-PE06 as shown in Figure 2 on both sides of both the leading edge spar and the main spar.

Align the wing building jig with the top wing layout, Plan 1 and pin in place. Pin the leading edge spar and main spar in place in the wing building jig. As shown in Figure 2 glue each forward rib half WF-L01 to the leading edge spar and the main spar. Start from the middle and alternate sides. Use a scrap piece of material as a square to insure they are vertical and perpendicular to the spars.

Glue an aft rib half WF-L02 aligned with each forward rib half. Be sure that the trailing edge is held down against the wing building jig. The last two ribs at each tip have shortened aft ribs WF-L03 and WF-L04 as shown on the plan. The diagonal brace strut (the most outboard aft rib is made from a length of 1x3mm strip 20 mm (.8”) long and tapered to 1.5mm at trailing edge. Notch it similar to the other aft ribs to accept the trailing edge wire.

Wing tips

The wing tips WF-L05 need to be tapered to fit between the leading edge spar and main spar as shown in Figure 3. They are glued so they are flush with the top surface of the spars. Bind in two places to each spar with a couple of wraps of thread as shown in Plan 1.

Trailing Edge

The trailing edge wire .35mm (.015”) dia is glued into the notches in the wing ribs as shown in Figure 2. Start at the center and work outward insuring that each aft rib half is well aligned. After each of the last three tip ribs and diagonal brace strut, gently bend the wire with needle nosed pliers to align for the next rib. Glue the trailing edge wire tangentially to the tip as shown in Plan 1. Finally, on the top wing, glue in the rib reinforcing bar, 1.5x2.5mm (1/16” x 3/32”) x 99mm (3.9”) long. This sits on top of the ribs as shown, aligned with the trailing edge wire. It will serve as a mounting point for the rudders. Note that there is not a reinforcing bar on the bottom wing.

The Bottom wing

The bottom wing layout is shown on Plan 2. It is identical to the top wing except near the middle. Only the differences between the two wings are discussed here.

FIG. 3 WING TIP DETAILS

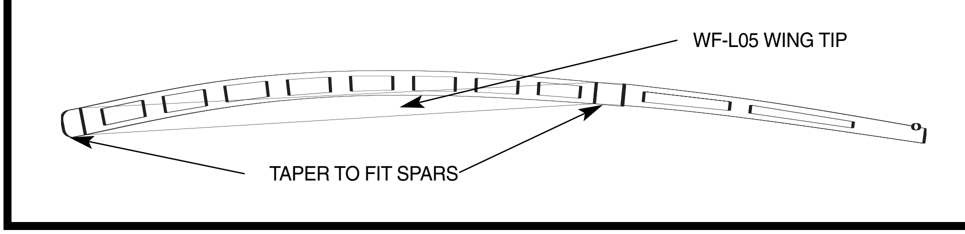
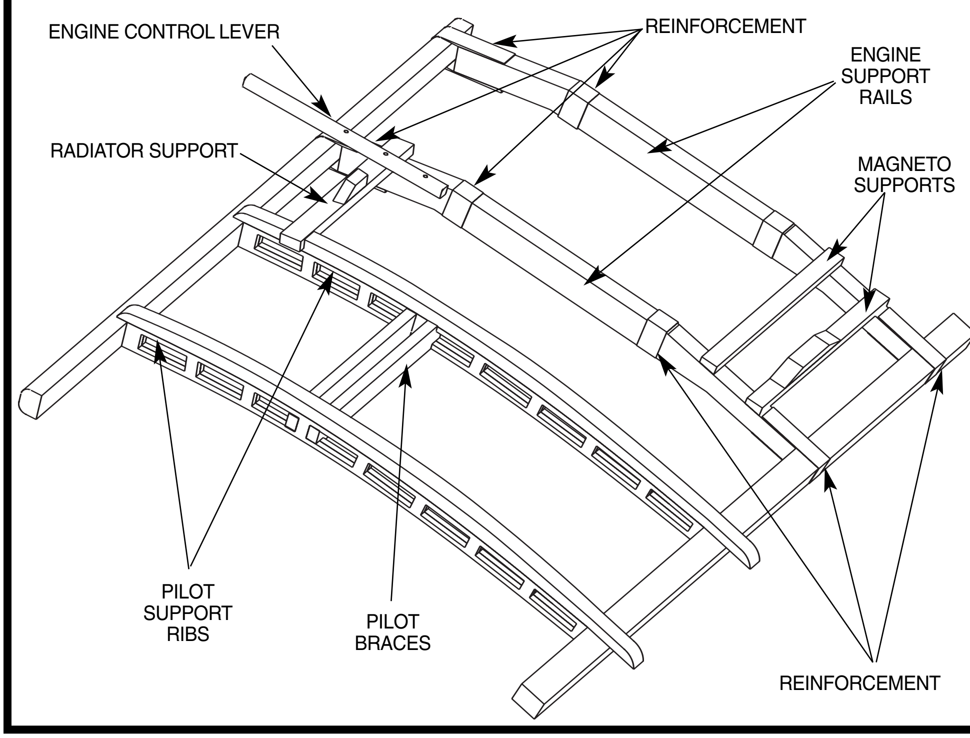
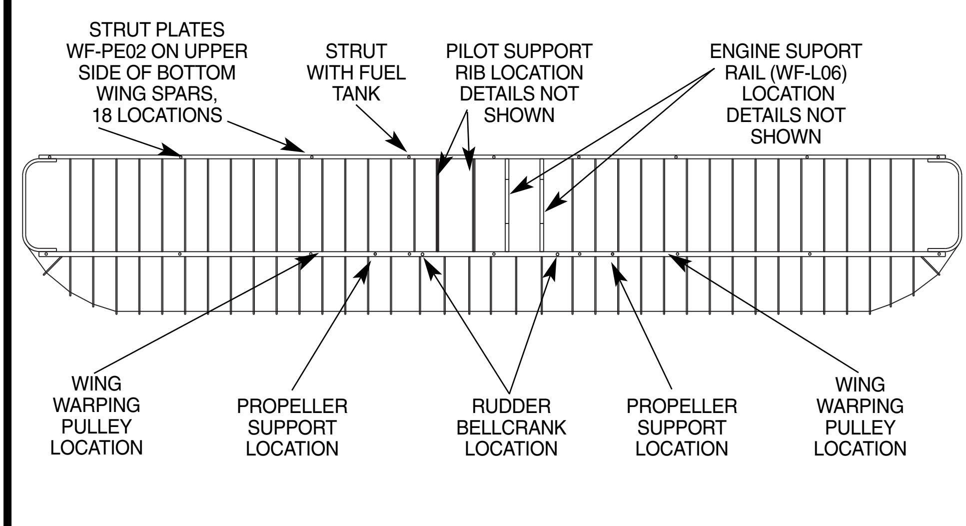


FIG. 4 PILOT SUPPORT RIBS AND ENGINE MOUNT STRUCTURE



PLAN 2 BOTTOM WING LAOUT



Before assembling the bottom wing drill holes in the top of the main spar for the propeller support assembly WF-B30 as described in the instructions for the top wing. Additionally drill .75mm (.031” (#68)) hole for rudder bell cranks at the two locations shown on Plan 2. Do not go all the way through the spar.

The two ribs just left of the center-line are the pilot support ribs. These are made by gluing two forward rib halves WF-L01 together and adding a 1.5x1.5 mm (1/16” x 1/16”) cap strip as shown in Figures 4 and 5. Additionally 2 strips of 1.5 x 2.5mm (1/16” x 3/32”) are fit between the pilot support ribs as pilot braces, as shown in the Figures.

The engine support structure is located just to right of the centerline on the bottom wing. This is made from the precut engine support rails (WF-L06) positioned as shown in Plan 2 and Figure 4. Before gluing these in place be sure the crankcase bottom WF-B14 fits the spacing between the support rails as shown on Figure 7.

The magneto front and rear support members are made from 1.5 x 2.5mm (1/16" x 3/32") stock. Taper the magneto support members so that the top surfaces are parallel with the top of the engine support rails. Be sure the magneto support members are mounted on the thinner (rear) end of the engine support rails. On the rear magneto support member add the tapered riser shown in Figures 4 and 5. Do not glue to riser to support until magneto installation.

The support rails are strapped to the spars with reinforcements as shown in Figure 4. Simulate this with 3mm (1/8") wide self-adhesive brass tape. There are two bands around the engine support rails where the engine sits and there are wraps around the spars as shown.

The radiator support and control base (all one piece) is made of 1.5 x3mm (1/16" x 1/8") x 30mm 19/16" as shown in Figs 4 and 5, and Plan 2. This part not only supports the radiator, but many of the control are fastened to it. Add to this the vertical tapered part (made from the same material) and engine control lever made from 1.5mm x 1.5 mm (1/16" x 1/16") material. Shim the control lever so that it is nearly horizontal as shown in Figure 5. The center hole in the lever simulates the pivot, the other two will be connected to the engine later.

Finally, note in Plan 2 that middle six aft rib halves do not align with the forward rib halves.

Wing warping cradle

The hip cradle controls the wing warping and the rudder motion. The pilot, lying on the bottom wing, shifts his hips from side to side to turn the airplane. The hip cradle and the foot rest are both made of 1.5 x 4mm (1/16" x 5/32") strips as shown in Plan 3. The operating arms, WF-PE08, are bent so that they can be pinned to the cradle and the pilot support rails enabling the cradle to be moved left and right. Use cut-off short lengths of straight pins for the pivots as shown in Section A-A in Plan 3. Leave sufficient room under the head of the pins holding the arms to the cradle to attach a thread to actuate the wing warping. This is described in the Stage 4.

The leather-covered cushion (the Wright's idea of comfort) is simulated as shown in Figure 6. Begin with a strip 1.5 x 4mm (1/16" x 5/32") x 38mm (1 1/2") long. Round it as shown in Section B-B in Plan 3. Notch the back surface 10mm (13/32") from each end about half way through. Cut the brown tape, WF-T1, as shown and wrap it over the strip. Bending the strip so that it breaks at the notches, the cushion can be glued into place.

Pin the cradle to the pilot support ribs and glue the footrest to the main spar.

FIG. 5 PILOT AND ENGINE SUPPORT DETAILS

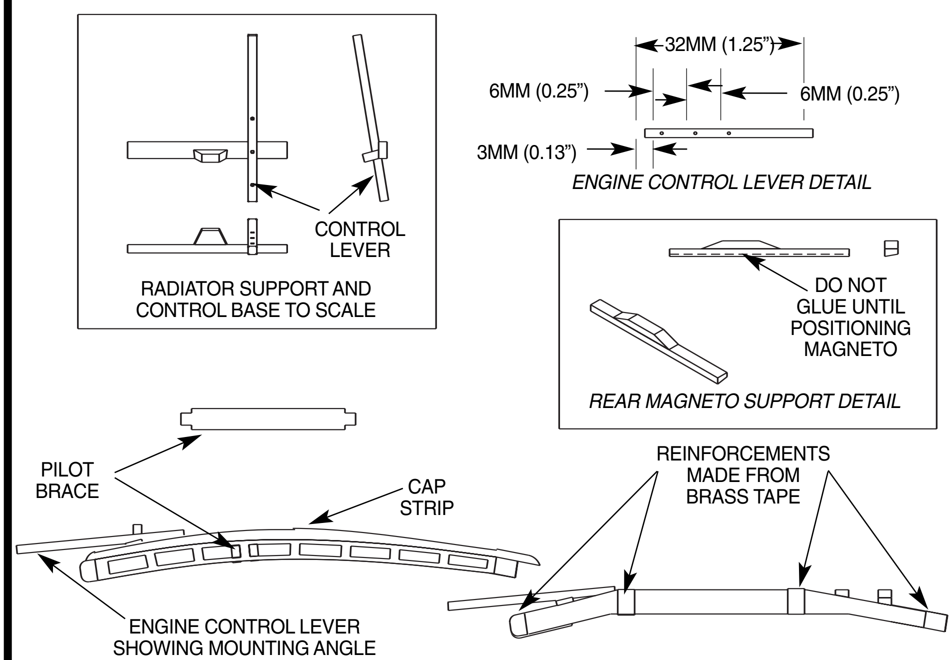


FIG. 6 WING WARPING CUSHON DETAILS

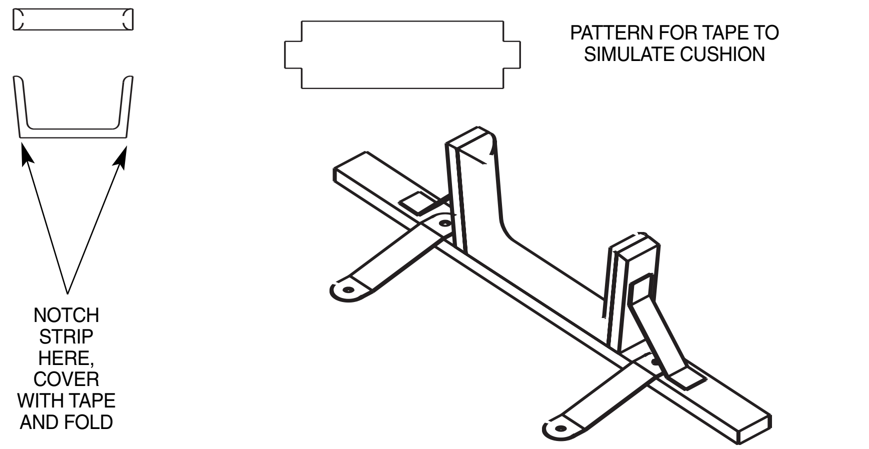
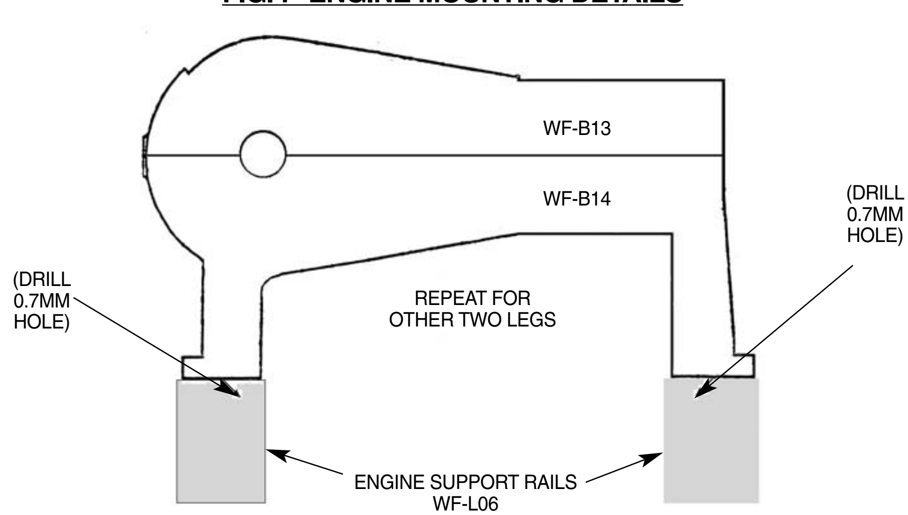


FIG. 7 ENGINE MOUNTING DETAILS



To balance the aircraft, pilot and engine were to be located approximately equidistant from the centerline. This meant that an engine delivering the minimum-required eight horsepower could weigh no more than 180 pounds, and must have minimal vibration to avoid damage to the fragile airframe. Not only was there no existing engine of the time that met the requirements, no manufacturer would risk the development expense to produce one.

Enter Charles W. Taylor, a former competitor and colleague in the bicycle repair business, who then worked for the Wright Brothers. Charlie Taylor, an accomplished "mechanician," hand crafted a horizontal, cast aluminum block, four-cylinder engine that weighed 170 pounds, fully fitted out, and delivered not eight but twelve horsepower. Since contemporary spark plugs were not reliable, they opted instead for an ingenious system of camshaft-driven breaker points mounted inside each of the four ignition heads. Only the exhaust valves operated from their own camshaft. The intake valves, however, were kept closed by springs and opened sequentially as each piston drew a suction in its cylinder. It is perhaps fortunate that the first flight was so brief. Fuel merely dripped into the hot intake manifold where the resulting explosive vapor was contained.

Care must be exercised with the many small parts. Refer to Figures 7 through 16 and the photographs. The keys to success are to carefully clean all of the castings, dry fit everything before applying glue and to keep in mind what you are doing at any given stage will affect how parts go together later. Note that the crankcase top and intake manifold have several raised spots that represent screw heads. If you happen to damage them while polishing the castings, they can be revived by placing an awl point in the center and then turning it in it in a circle while maintaining moderate pressure. If doing this for one screw head, do it for all of them on that part to maintain consistency. For best results, follow this up by placing a drop of white glue in each of the centers to build them up.

Crankcase and intake manifold

Before assembling the crankcase halves, drill a .7mm hole in each foot of the crankcase bottom (WF-B14). These must be drilled at an angle against where the foot meets the leg. Refer to Figure 7.

Referring to Figure 8, assemble crankcase halves (WF-B13 and WF-B14). Insert, but do not glue or cut the crankshaft (KS126) to help align the parts. The four bore plugs will align the parts in the other direction. Next, putty and sand the resulting seam, if necessary, before you attach the two crankshaft clamps (WF-B15). Note that they should be angled 45 degrees to the horizontal. Re-

FIG.-8 ENGINE BLOCK ASSEMBLY

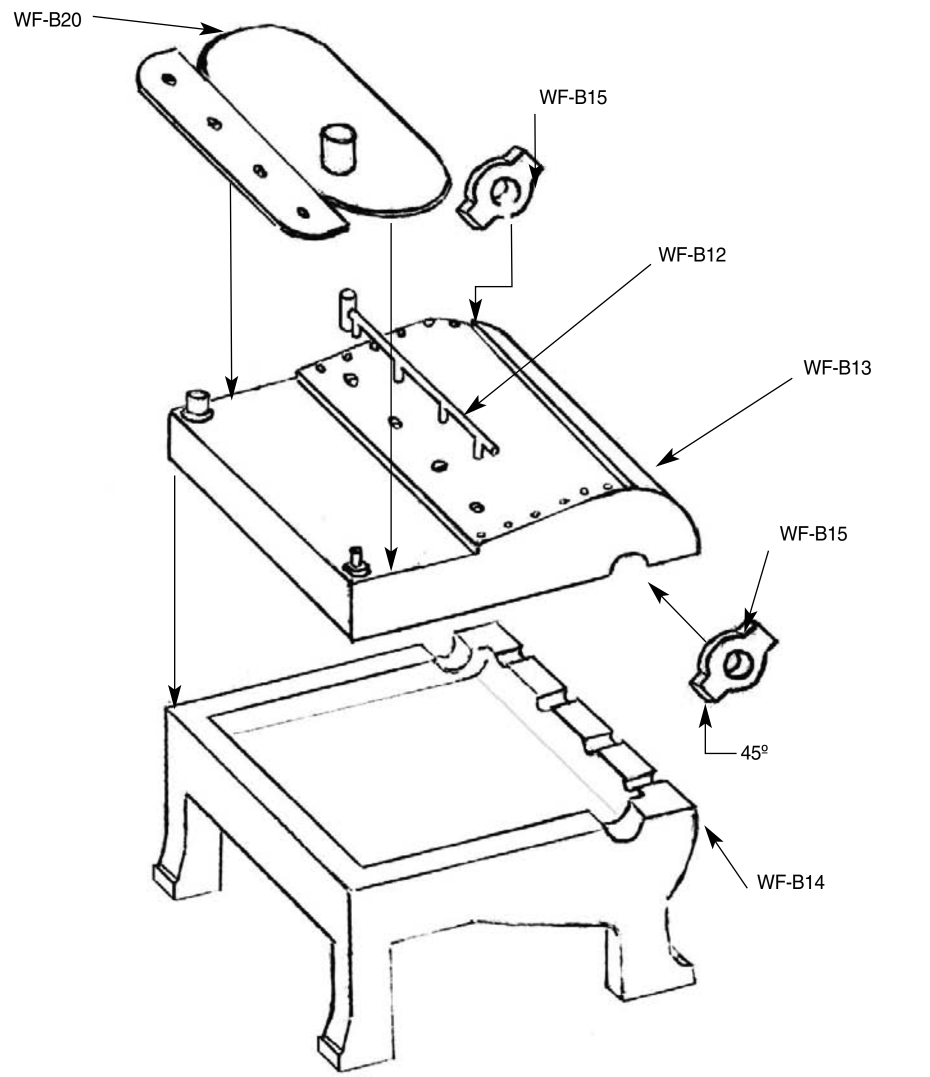
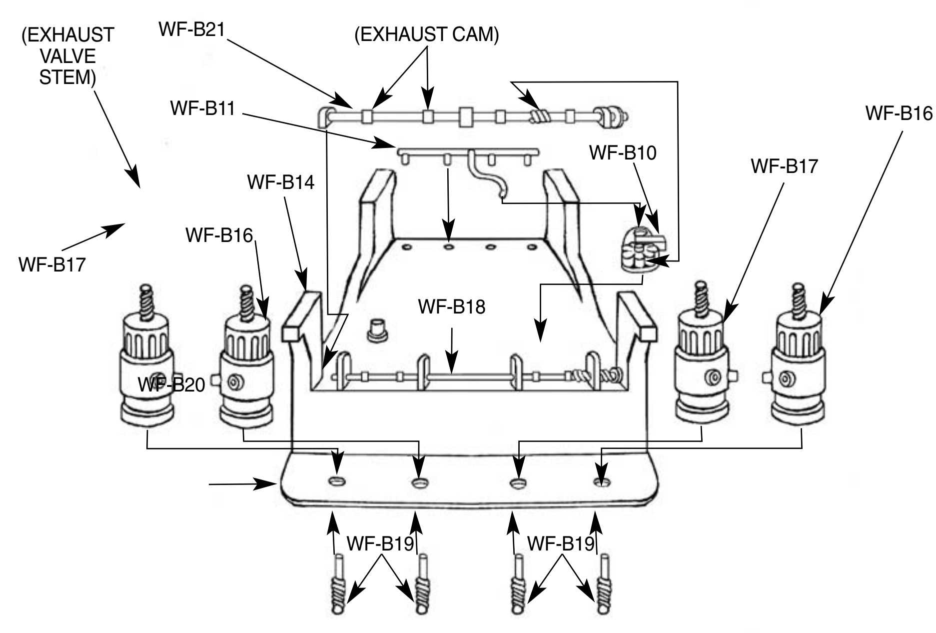


FIG.-9 CYLINDER AND CAM ASSEMBLY



inserting the crankshaft will facilitate this, but be careful not to glue the crankshaft in the process. The intake manifold (WF-B20) fits between the water and steam fittings atop the crankcase and against the step. Adjust the fit so the straight edge inboard of the four holes lines up with the outer edge of the crankcase and the entire part is positioned equidistant from the crankcase sides and glue it in place. The fit of the oil distributor (WF-B12) will be tight. Any required adjustment should be made by filing the backside of the end fitting where it fits against the engine's side.

Cam shafts, ignition heads and oil pump

This step requires care since you have to align both cam shafts and the ignition heads at the same time. Refer to Figures 9 and 10. Note that ignition heads (WF-B16 and WF-B17) form two right and left pairs with pins pointing between each pair. Lay the crankcase upside down and, using a soft pencil, draw alignment marks from the four holes on the underside of the intake manifold out to the edge, perpendicular to the engine face.

The flat on the side of the ignition heads (WF-B16 and WF-B17) goes against the crankcase face, so the exhaust ports face out. Drill a 1/16" hole into the top center of each ignition head, deep enough to accept about half the length of an intake valve stem (WF-B19). Don't worry that the hole looks too wide, this will simplify inserting the intake valve stems later. Carefully check the fit of each ignition head and gently file where necessary to achieve the best fit. Using your pencil marks as guides, one-at-a-time center each ignition head and glue it to the intake manifold and the engine face. Any minor gaps can be filled with a little more superglue.

Position - do not glue - the ignition camshaft (WF-B18) between the engine legs. With the engine upside down and the ignition heads away from you, the ignition camshaft end with the springs goes to the left, as shown in the figures. The tall posts on the ignition camshaft should line up with the four exhaust valve stems. You might have to carefully bend the posts a bit to make the alignment. Once you have done this, glue the ignition camshaft in place, making sure the tall posts come right to the edge of the engine, since the posts were part of the crankcase casting in the actual engine.

Next, affix the exhaust camshaft (WF-B21) almost against the legs so that the end with the sprocket fitting extends past the engine to the left as shown in Figure 10. The flats of the three mounting posts (left, middle, right) on this part are glued to the engine bottom. With the four cams roughly lined up with the tall posts on the ignition camshaft, the left edge of the left post should be about at the engine's edge.

Glue the oil pump (WF-B10) in place against the exhaust camshaft gear, then glue on the crankcase oil collector (WF-B11). Carefully bend the "S" tube coming from it so its end fits into the hole in the oil pump.

PLAN 3 WING WARPING CRADLE

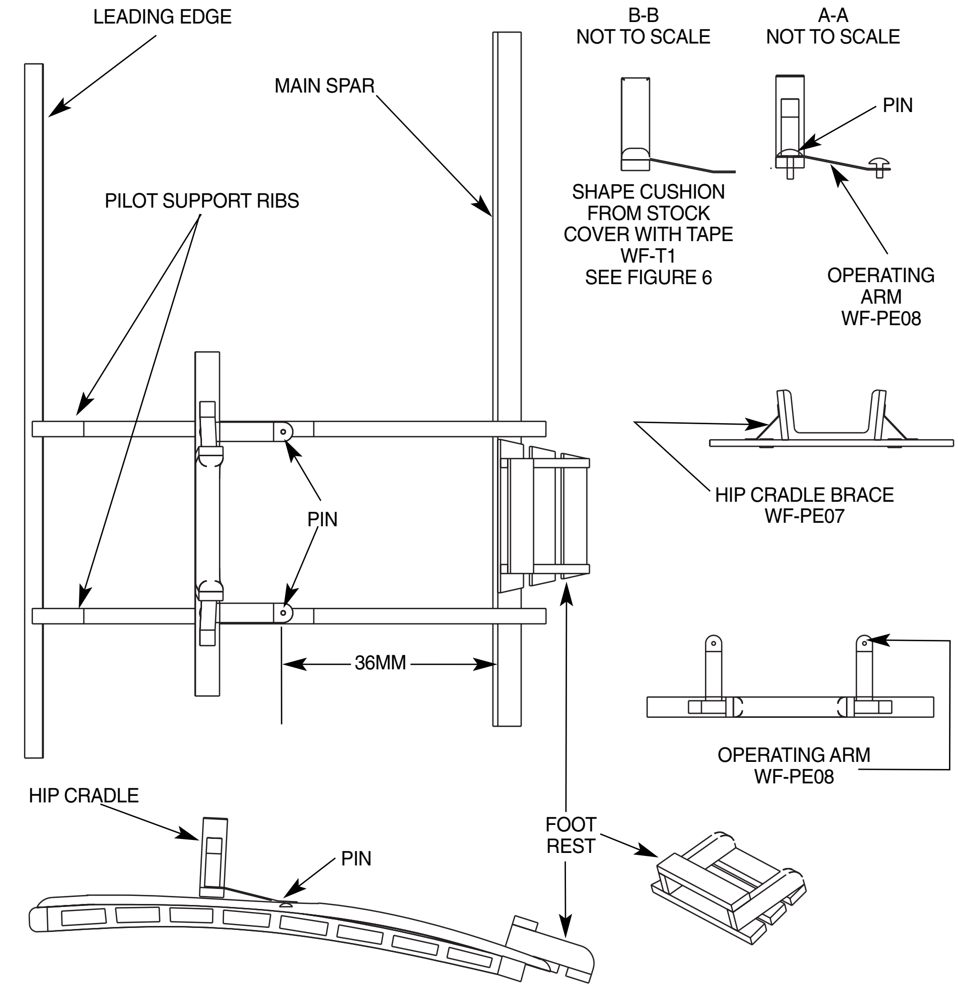
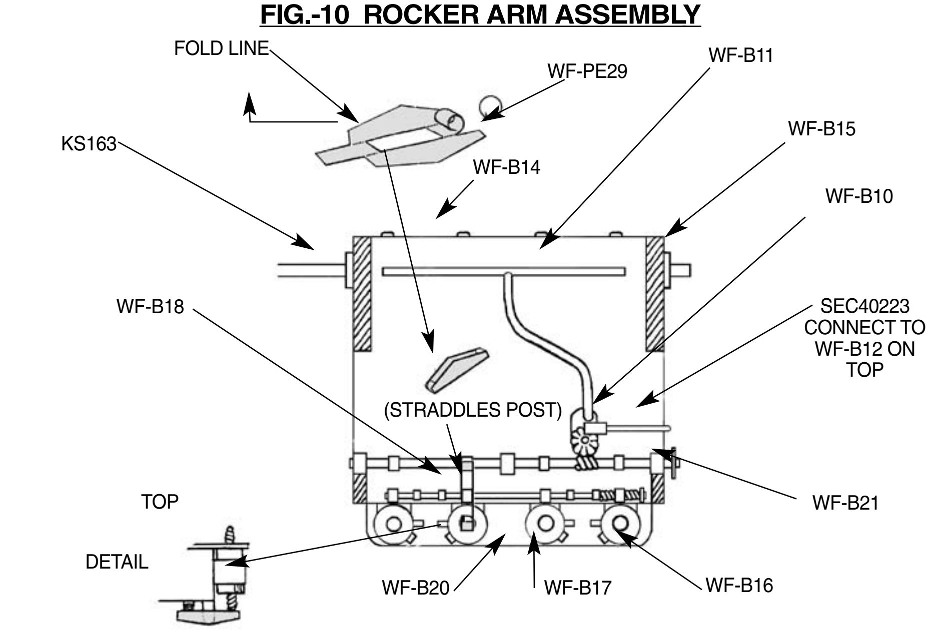


FIG.-10 ROCKER ARM ASSEMBLY



Bend and glue in place the four exhaust rocker arms (WF-PE29). Roll the tabs inward as shown in Figure 10, before bending up the sides.

Turn the engine right side up. Shorten the intake valve stems (WF-B19) from the plain ends so the cast valve spring on each one fits tightly to the intake manifold, then glue them into their holes.

Cam followers and ignition terminal

Referring to Figure 11, carefully bend the two ignition cam followers/springs (WF-PE27) and then attach them so their long ends rest against the posts on the ignition heads, and the short ends rest against the cams on the ignition camshaft. Bend the long loop against the engine face.

The ignition terminal bolts and the engine mounting bolts are represented by eight small brass nails (MS0940). These must cut as necessary. Drill a .7mm (.020") hole in the small raised ring on each ignition head to accept the terminal bolts.

Now is the time to paint the engine "gun-metal" and apply a darker wash and highlights, if desired.

Bend the ignition terminal strip (WF-PE28) as indicated and affix it by gluing in the terminal bolts in ignition heads 1 through 3. The fourth bolt will be installed after the engine and magneto are affixed to the airframe.

Fuel and oil lines, camshaft drive chain and sprockets

Referring to Figure 12, cut and bend enough 22 gauge copper wire (SEC40223) to form the pipe connecting the oil pump (WF-B10, see Figure 10) to the oil distributor (WF-B12) on the top of the engine. Keep the oil pipe as close to the side of the engine as possible. Repeat this for the copper fuel line, which is glued into the hole in the can atop the intake manifold. The fuel line runs across the manifold and down the engine side, keeping it as tight to the side as possible. The fuel line is about 1-5/8" long. The bends are clearly shown in Figure 12 as well as in the engine photograph.

Paint sprockets WF-PE31 and PE32 steel. Glue the camshaft sprocket (WF-PE31) onto the camshaft end. Cut off 45mm (1-3/4") of KS126 to make the crankshaft. Cut 6mm (1/4") of (KS1160) to make sprocket pin. Make sure one end is clean and square. Insert the undressed end of the sprocket pin into the crankshaft, leaving 1mm (1/32") protruding and glue into place. Glue the crankshaft sprocket (WF-PE32) onto the pin, against the shoulder created by the crankshaft.

Stretch the drive chain (MS2017) out straight and cut off 66mm (2-19/32") of it. Open one link and attach it to the other end to create a loop with no twists. Stand the engine on its end and drape the looped chain over the camshaft sprocket. Glue it in place, and then insert the crankshaft through the loop and into the engine so that the chain engages the crankshaft sprocket. Spot glue the chain to the crankshaft sprocket. Test fit the tensioning roller/bracket (WF-B23) and bend it if necessary to raise the roller end to better fit against the chain, then paint and glue the tensioning roller in place so that the roller lifts the slack in the chain.

FIG.-11 IGNITION ASSEMBLY

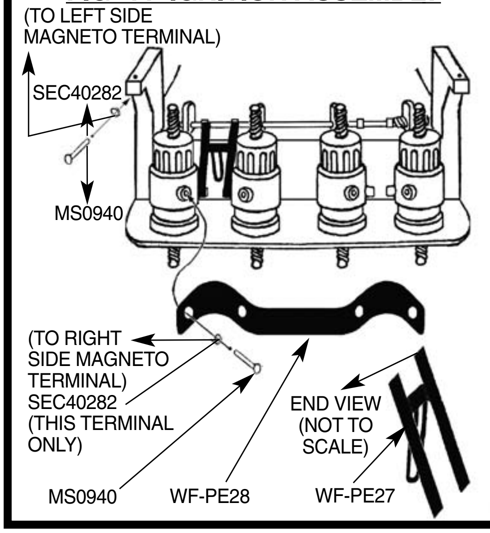


FIG.-12 CAM DRIVE AND FUEL LINES

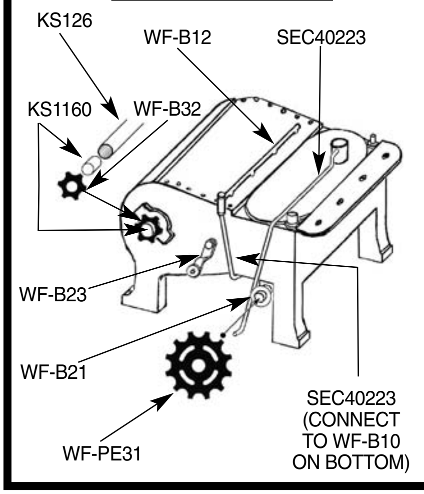
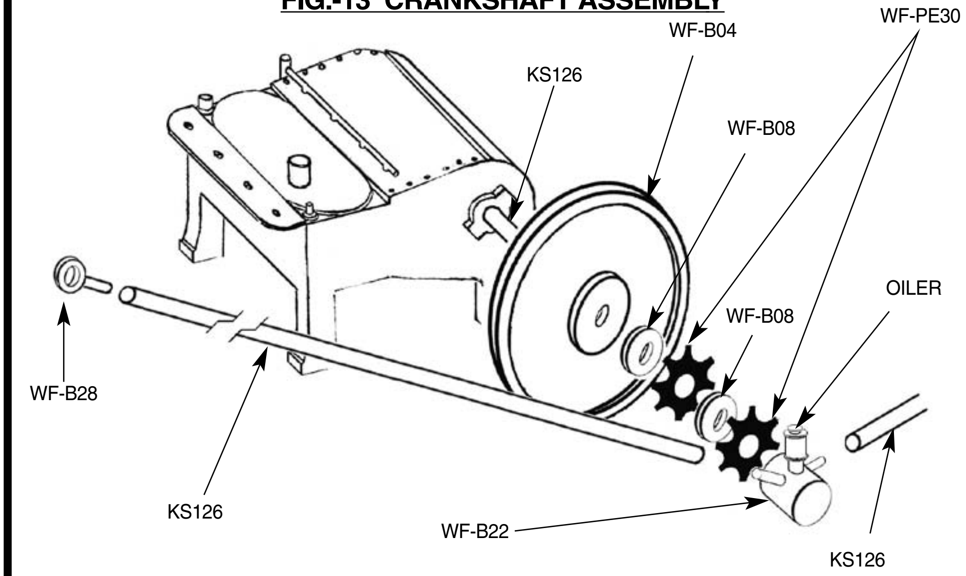


FIG.-13 CRANKSHAFT ASSEMBLY



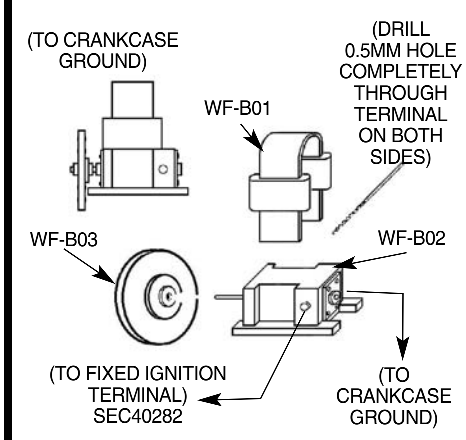
Referring to Figure 13, slip the engine flywheel (WF-B04), the shaft sprocket spacers (WF-B08) and the drive sprockets (WF-PE30) onto the other end of the crankshaft. Put a drop of glue inside the shaft oiler/guide support mount (WF-B22), then glue this onto the end of the crankshaft, making sure that the oiler points straight up.

Magneto

Referring to Figure 14, drill .25mm holes (#80 twist drill) through the terminal posts on the magneto rotor housing (WF-B02). [If you find it too difficult to drill through the terminal posts as shown, you may instead drill a hole into the end of each terminal.] Cut the provided ignition wire (WP1750) in half and affix one half to each of the terminals.

Attach the stator coil (WF-B01) to the housing. Attach the magneto friction wheel (WF-B03) on its axel as shown. Paint the assembly gunmetal except for the raised wheel rim which should be leather brown. The thick windings on the stator and the terminal posts may be painted copper.

FIG.-14 MAGNETO ASSEMBLY



[An additional four brass nails are provided as an option in mounting the magneto. You must drill a .7mm hole in the front and rear tabs of the magneto base to accept them. Cut the nails almost back to their heads, so they do not protrude through the underside and glue them in at this stage. If you choose this option, drill the holes before assembling the parts.]

Installing the fuel valves

Referring to Figure 15, attach the gas cock handle (WF-PE26) to the gas cock (WF-B09) so the handle is at a right angle to the axis of the valve body. With the long part of the handle pointing toward the rear of the aircraft, glue the assembled gas cock to the left engine support, against the cross bar which carries the actuating control stick and the radiator support.

Next, glue the fuel metering valve scale (WF-PE25) to the fuel metering valve (WF-B07), then attach the fuel metering valve handle (WF-PE24) into place so that the pointer falls about midway on the etched scale markings. Glue this subassembly, as indicated, to the front of the cross bar, to the left of the radiator support.

Join the two fuel valves with a 18mm (3/4") length of 1.5mm (1/16") OD tubing (part WP1730). It will be easier to install the fuel line if you first stretch the ends by working them onto an ice pick or scratch awl.

Installing the engine, magneto and revolutions counter

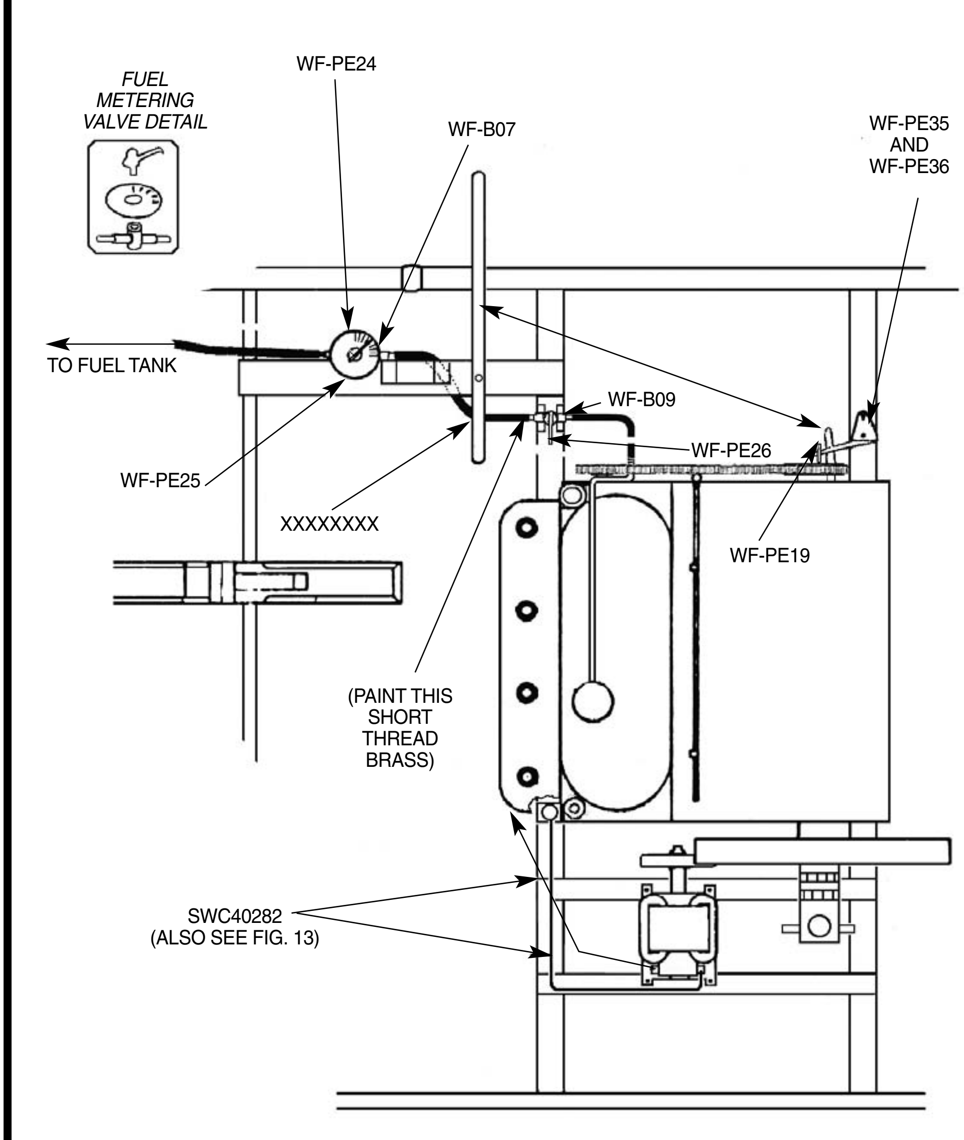
Because the ignition ground wire must be attached to one of the engine mounting bolts, the bolts are represented by brass nails inserted into the holes you previously drilled. This method was chosen to facilitate assembly and to produce a consistent look to your model. Cut off three brass nails (MS0940) so they do not protrude from the bottom of the holes drilled in the feet, and glue these into the holes on three of the crankcase legs only. This will make it easier to attach the ground wire to the fourth leg (the one under ignition head #4) after the engine and magneto are installed. Glue 2 1/2" of 3/32" OD tubing (WP1731) to the bottom crankcase nipple (shown in Figure 11) with a 90 degree bend so the tubing emerges between ignition heads 3 and 4.

Referring to Figure 5, using quick-set Epoxy for strength, glue the engine to the engine mounting supports so that the flywheel faces to the rear of the aircraft. Join the copper fuel line on the engine to the gas cock using 16mm (5/8") of 1.5 mm(1/16") OD tubing (WP1730).

Glue the magneto into place on its supports so that the rim of the magneto friction wheel touches the rim of the engine flywheel.

The ignition wire on the left magneto terminal goes to the ignition terminal strip(WF-PE28). Determine the needed wire length, then wrap the free end around a cut brass nail (MS0940) and glue the brass nail through the ignition terminal strip into ignition head #4. The right side wire from the magneto is the ground, which attaches to

FIG.-15 PLUMBING AND WIRING

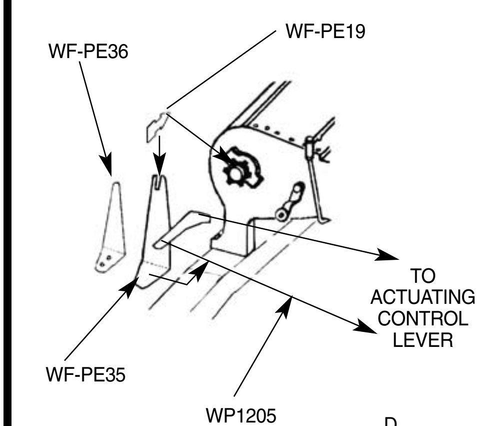


the crankcase leg in a similar manner.

Referring to Figure 16, glue the revolutions counter (WF-PE19) into the slot on the end of the revolutions counter bracket (WF-PE35). Next fold the base and twist the side cam arm to parallel the base. Glue 50mm (2") of thread to the holes at end of the cam arm. The second hole at the narrower end remains empty. Test fit the bracket against the engine so that the cam touches the crankcase and the counter point just misses the center of the crankshaft. After adjusting the alignment, glue the base to the engine support. Next bend the base of the revolutions counter bracket stiffener (WF-PE36). Adjust the angle so the stiffener nests perfectly into the revolutions counter bracket, then glue it in place.

Run the thread from the part of the cam that touches the crankcase to the rear hole on the actuating control lever and the thread from the other end of the cam to the front hole on the actuating control lever. Be careful not to pull them too tight. Paint a brass color enough thread to run from the

FIG.-16 SPEED CONTROL MECHANISM



rear hole on the actuating lever to the end of the handle on the gas cock handle and glue it into place to represent the actual metal connecting rod.

STAGE 3: ASSEMBLING AND RIGGING THE WINGS

In this stage the engine, drive and wings are assembled and rigged. This is done in a wing assembly jig that holds the wings and drive train in the proper orientation making assembly easier.

Wing Assembly jig

The wing assembly jig is used to align and rig the wings with the wing truss wires and control wires. Four pieces each of laser-cut parts WF-L08 and WF-L09 are included. Glue in pairs using 1/32" diameter locator holes to yield 2 pieces each of both WF-L08 and WF-L09. Assemble WF-L08 to WF-L11 according to Figure 17. Be sure that the inner wing assembly jig is not confused with the outer one. When properly assembled, the jig will result in the wings tips drooping lower than the center section.

Set the bottom wing in the wing assembly jig, leading edge first. Be sure it is centered. Use rubber bands or pieces of thread to hold it securely in place. It will not be removed until the airplane is nearly completed.

Drive train installation

The drive chain assembly is referenced in Figures 13, 19 and 20. Step one is to determine the lengths of the chain guide supports which are made from lengths of brass tubing 2.5mm (3/32") dia (KS126). Slight discrepancies can occur in each built-up model, so it is highly recommended that you cut the brass tubing a little long and test fit and trim it as needed. The left chain guide support should be around 139mm (5-1/2") long and the right support should be approximately 69mm (2-23/32") long. Cut the tubing long and glue a guide support eye (WF-B28) into one end of each. Note that the guide supports do angle slightly forward from their attachment pins on the crankshaft oiler.

Once you have determined the required length of each chain guide support, glue propeller shaft supports (WF-B30). The left chain guide (WF-B27) should be positioned so the center of the post is 30mm (1-3/16") from the crankshaft end of the support. The right guide (WF-B26) is roughly centered on its support. Make certain that the guide support eyes are precisely parallel to each chain guide. Cut some 1.5mm (1/16") wide strips of the brass tape (MS1810) to make the reinforcements at each joint between the chain guides and their supports. Also completely wrap the center of the left support and guide where the guide tubes cross. Glue the left guide support brace (WF-B29) to the left support and attach the chain guide rollers (WF-B25) to the left chain guide. It is easiest to attach the drive chain (MS2017) to the roller guides at this point. Do not cut the chain until you have wrapped it around the crankshaft sprocket and determined the needed length to attach it to the upper left chain guide.

Glue the chain guide assemblies into place and glue the propeller shaft supports

FIG. 17 WING ASSEMBLY JIG

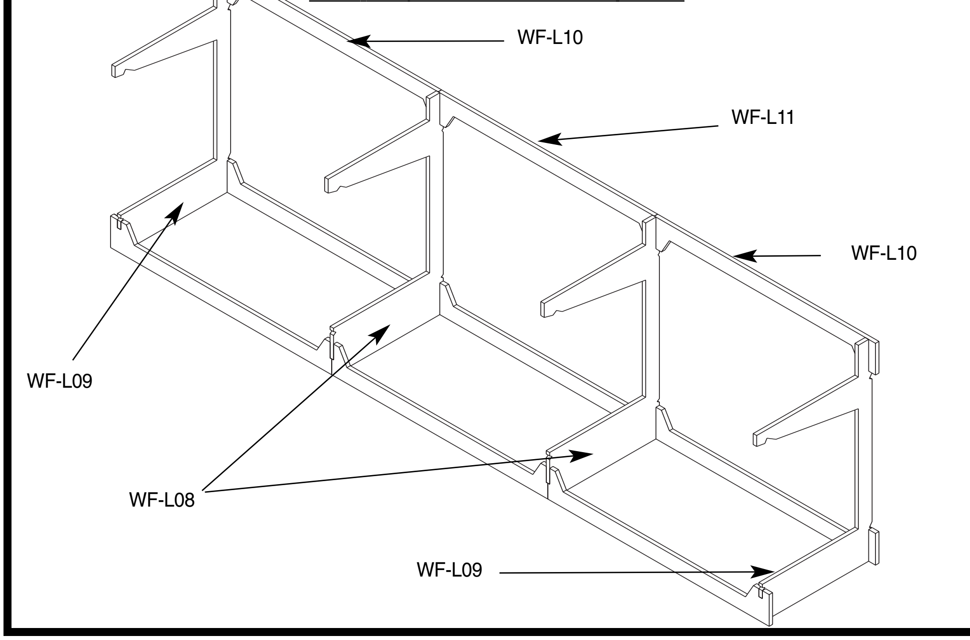


FIG. 18 PROPELLER SUPPORT ASSEMBLY

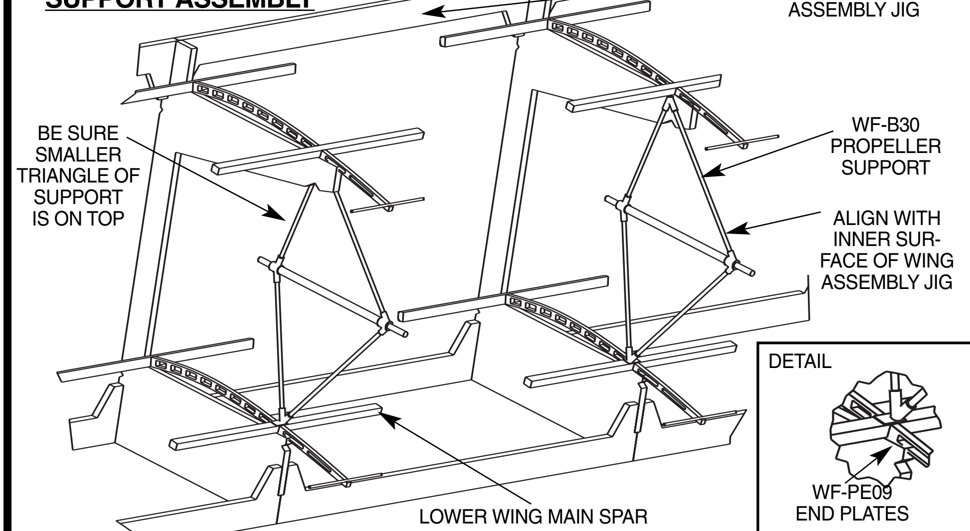
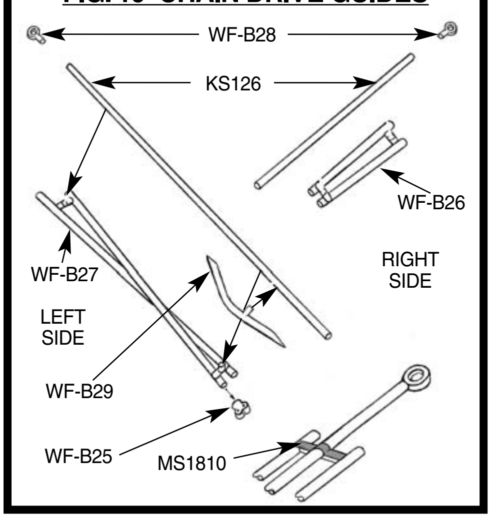
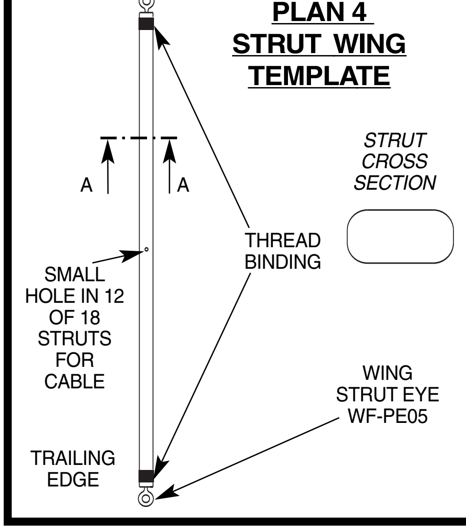


FIG. 19 CHAIN DRIVE GUIDES



PLAN 4 STRUT WING TEMPLATE



(WF-B30) and their base plates (WF-PE09) to the rear spars. Glue the drive sprockets (WF-PE10) to the ends of the propeller shafts.

When attaching the drive chain to the two crankshaft drive sprockets and the two propeller sprockets, attach the chain to the lower guide first, then wrap it around the sprocket and cut and glue it to the upper guide. Gluing the chain to each sprocket as you wrap it will facilitate the procedure. Take your time and think this through before you start because this is the trickiest step of the entire model assembly. [HINT: Coating several links from an end with super glue will stiffen the chain, making it easier to grasp and insert into the chain guide ends.]

Strut fittings

Glue the 36 strut fittings WF-PE04 onto the strut plates WF-PE03 as shown in Figure 21 using epoxy. On the bottom wing, glue the strut plates on the top side of both wing spars in the locations shown on Plan 2. The plates on the leading edge should be flush with the back edge of the spar and wrap around the top of the leading edge. The longer part of the strut fitting should be outboard. Duplicate the process on the bottom of top wing. Be sure the fittings line up between the two wings and that the fittings have been installed on the bottom of the top wing. Either the wing building jig or the assembly jig can be used to hold the top wing while installing these parts.

Wing Warping Pulleys and Wire

The wing warping rigging is shown in the lower section of Figure 24. The wing warping system is composed of the cradle (assembled earlier) a set of 4 pulleys (detailed in Figure 22), a top warping wire (detailed in Plan 5) and a bottom warping wire (detailed in Plan 5).

The wing warping pulleys are made by folding the housing WP-PE02 as shown in Figure 22. Be sure to fold two in each direction as shown. The pulley itself is made of a short length of 3mm 1/8” dia. aluminum tubing cut 2mm (.08”) long and glued into the housing. This tubing can be easily cut by rolling the tubing back and forth on a flat surface while pressing down on it with a knife blade. Glue the pulleys in place on both wings.

The wing warping wires should be made from the thread (WP-1205) the using the templates in Plan 5. The lower wire attaches to the cradle, the wing tips in two places and the rudder. Both wires include short lengths of chain WF-M1 where the wires go through the pulleys. For now thread the lower wire through the pulleys on the bottom wing (Figure 24 and attach to the wing warping cradle as shown in Plan 5. Attach the two short tension wires that connect to the wing ribs as shown in Plan 5. These stabilize the wire. Temporarily secure the ends of the wire that fasten to the top wing and to the rudder with a small rubber band and tuck them out of the way.

FIG. 20 CHAIN DRIVE ASSEMBLY

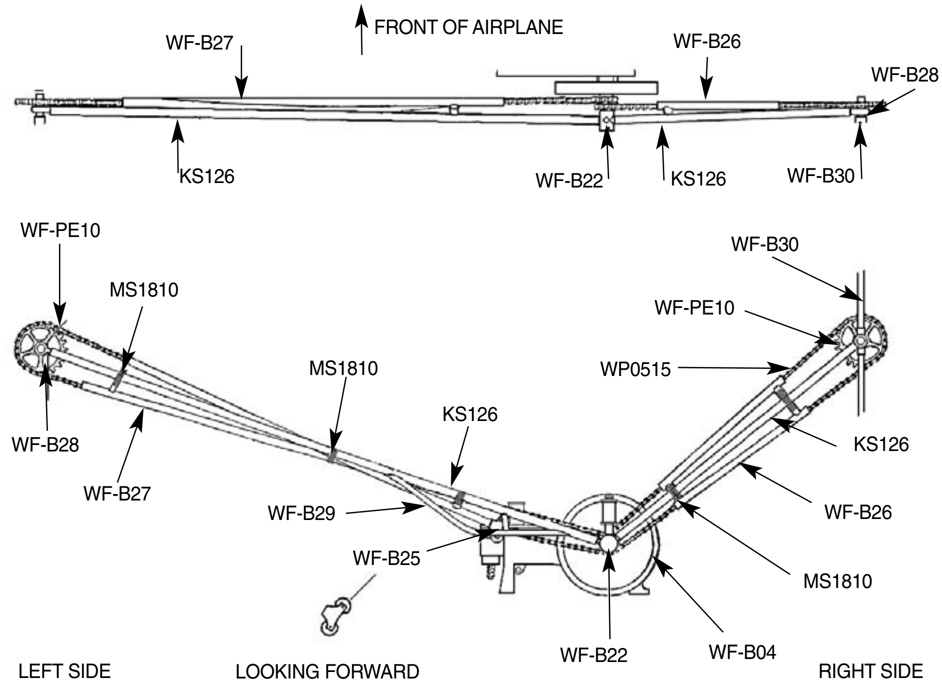


FIG. 21 STRUT END ASSEMBLY

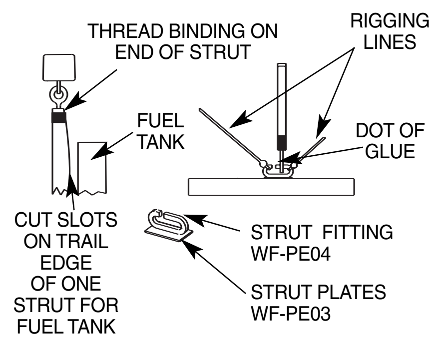
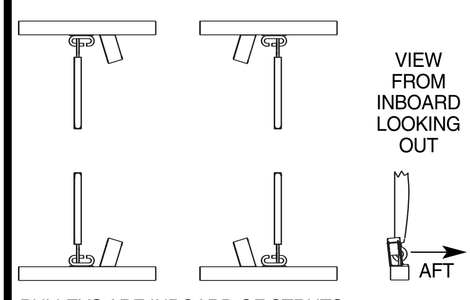
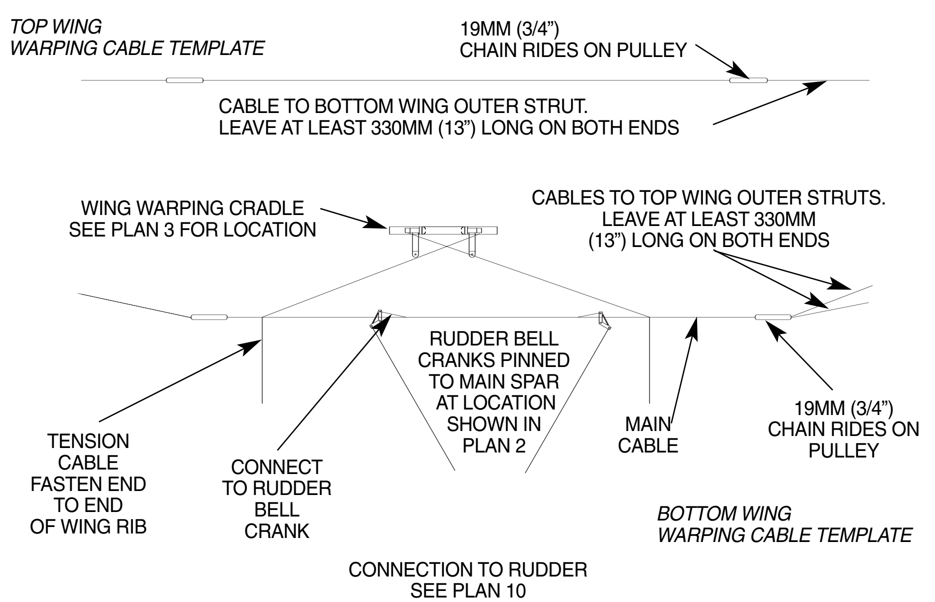


FIG. 22 WING WARPING PULLEY



PLAN 5 WARPING WIRES



Install the rudder bellcranks (WF-PE01) at the locations shown on Plan 2. Attach to the wing warping wire with short lengths of thread as shown. As with the wing warping wires temporarily secure the ends that go to the rudder.

Wing Struts

Cut 18 struts to length 110mm (4.35”). Use Plan 4 as a template. As shown, struts are slightly tapered on the trailing edge and all four edges are rounded. Bind each end of each strut with thread for about 3mm (1/8”) as shown in Figure 21. Glue the thread in place. Drill or poke a .5 mm (.020”) hole in the center of each end of each strut at least 6mm (1/4”) deep. Glue the wing strut eyes WF-PE05 in both ends of each struts and be sure the center distance between eyes is 116mm (4.55”) as shown in Plan 4. Note that all the leading edge struts (except those at the tip) and the five center struts in the rear (for a total of 12 struts) have a hole drilled half way up for the horizontal truss wire.

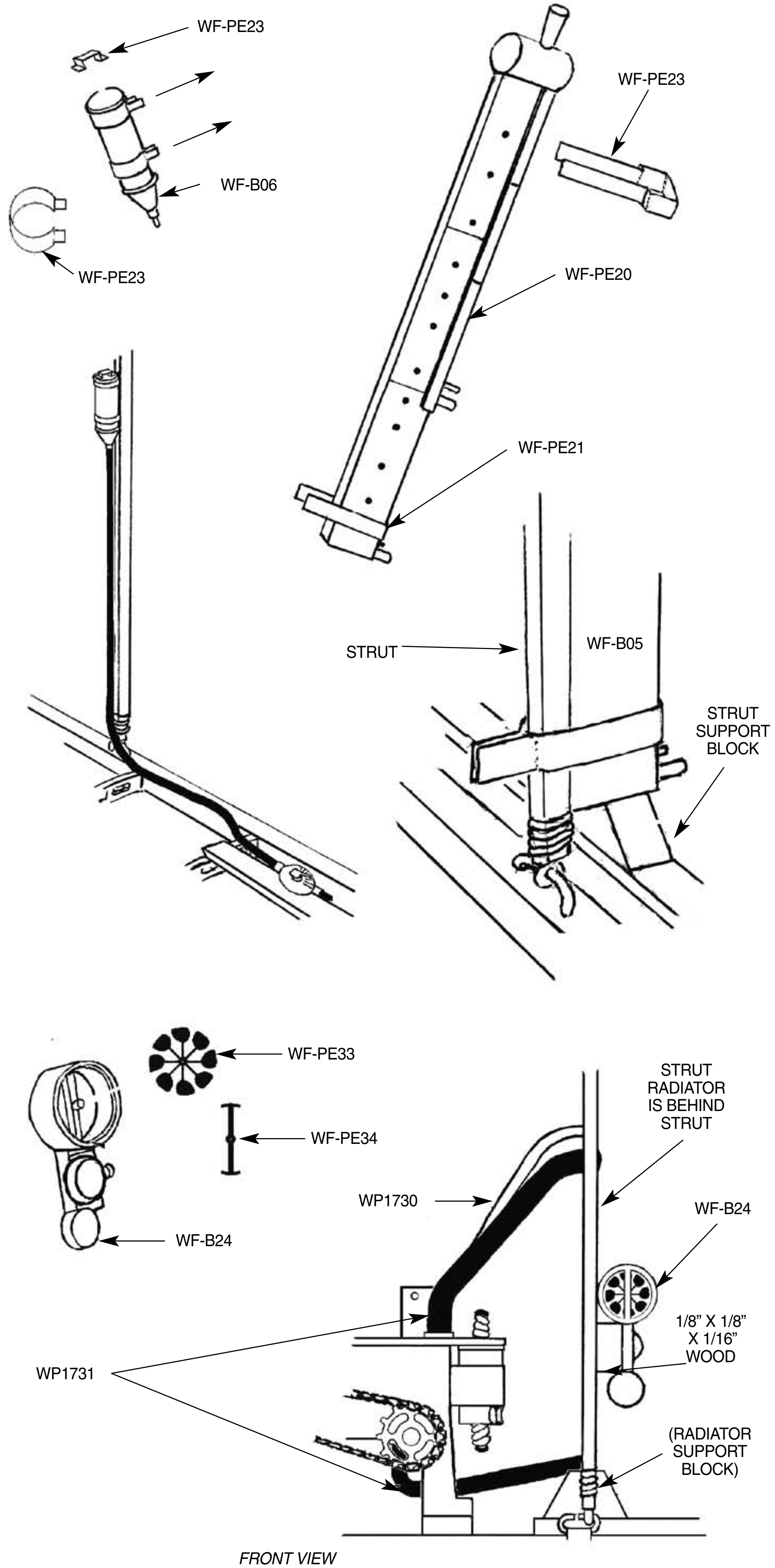
For the strut that carries the fuel tank (just to the left of the pilot, identified in Plan 1) measure down 12mm (1/2”) from the center of the eye and make a mark on the trailing edge as shown in Figure 21. Make a second mark 13.5mm (17/32”) below the first one. Carefully work a vertical slot into the strut at each location. These will later accept the tabs on the fuel tank (WF-B06).

Installing the fuel tank, radiator and anemometer

Referring to Figure 23, attach the two fuel tank straps (WF-PE22) to the fuel tank (WF-B06). The top strap is located under the top rim of the fuel tank, and the lower edge of the bottom strap should be 1.5mm (1/16”) above the bottom rim. Be careful that the tabs created by pinching the ends of each strap line up. Attach the fuel tank handle (WF-PE23) so it lies front to back, the strap tabs indicating the front. Next, attach the fuel tank to its strut by inserting the tabs into the previously prepared slots (Fig 21). Finally, attach the fuel line from the tank to the fuel metering valve. This will require 137mm (5-3/8”) of 1.5mm (1/16”) OD tubing (part# WP1730) that should run from the nipple on the tank, down the strut, then across the front spar to the valve nipple. [HINT: the best way to make the tubing lie where you want it is to slip in some scrap bare wire where the bends will be made. This also will counteract the natural tendency of the radiator hoses to straighten out and pull off the engine nipples.]

Find the center of the top radiator strap (WF-PE20). Lay this on a small hardwood (or other material) block so that you can hold the radiator, nipples down, against the strap. This will facilitate getting tight bends along the radiator as in Figure 23. Note that the top section of the radiator has a thick-ened section. With your thumbnail, or nee-dle nose pliers, make step bends in the strap

FIG. 23 GAS TANK, RADIATOR AND ANEMOMETER MOUNTNG



to conform to this. The procedure for the bottom strap (WF-PE21) is similar but without the step bends. Glue the bottom strap to the radiator, just above the plug above the bottom nipple. Glue the top strap just under the top rivet.

Rest the radiator on the support block, sliding the straps over the strut. Using needle nose pliers, crimp the strap ends together in front of the strut. Glue the ends together with epoxy and clamp until the glue sets. Finally, trim each tab to about .75mm (1/32"). Using 2mm (3/32") tubing (part# WP1731), connect the bottom radiator nipple to the one underneath the engine and the larger of the two remaining radiator nipples to the forward nipple on the engine top using 37mm (1 1/2") of 2mm (3/32") OD tubing. The rear nipple on top of the engine is a steam line which uses 60mm (2-3/8") of 1.5mm (1/16") OD tubing (part# WP1730) to connect to the thin nipple on the radiator.

Glue the center of the anemometer blades (WF-PE33) to the pin inside the housing of the anemometer/stop watch assembly (WF-B24). The anemometer bracket (WF-PE34) in then glued across the rim of the housing in line with the length of the cast part. Measure up 12mm (1/2") from the bottom of the radiator and glue a 3x3x1.5mm (1/8" x 1/8" x 1/16") piece of wood strip MS3820 to the left side of that strut. Glue the back plate of WF-B24 to this block with the anemometer head up.

Wing Assembly

When the top wing is added and the rigging is in place, the aircraft's truss-like structure will hold the wings rigid with the tips drooping down.

First install the struts on each strut fitting on the top wing. It is easiest to do with the wing lying upside down. Put a small dot of glue on the strut fitting to hold each strut on, but free to pivot on the fitting as shown in Figure 21. Be careful that the curved side of each strut faces aft.

Install the end plates for propeller support (WF-PE09) on both wings. They should be positioned over the holes drilled earlier for the propeller supports. The long portion of the plate should project outboard. Test fit the top wing and with only the inner most struts connected check to see that the propeller support fits well into the endplates.

While the top wing is inverted install the wing truss wires. It is these wires that give the wing structure its stiffness. On each of the strut fittings on the underside of the top wing tie (see Figure 21) one end of a length of thread at least 250mm (10") long and glue the knot. Keep the knot as small as possible and use just enough glue to soak into the knot. Refer to Figure 24 to determine how many threads to tie onto each strut fitting. Figure 24 a shows the span wise rigging for the leading edge struts (on the left) and those on the main spar (on the right). Figure 24 b-d show the fore-aft rigging. When the rigging is completed the center section of the structure will be rigid and the trailing edge of the tips will be free to flex up and down to control the aircraft's roll. This wing warping was patented by the Wrights.

Install the wing warping wire in the top wings, if you have not already done so.

Turn the top wing over (right side up) and position over the bottom wing in the wing assembly jig . Starting at the middle align and attach the struts to the bottom wing and the propeller shaft/support to the top wing. As with the top wing, put a dot of glue on the fittings to hold the struts in place.

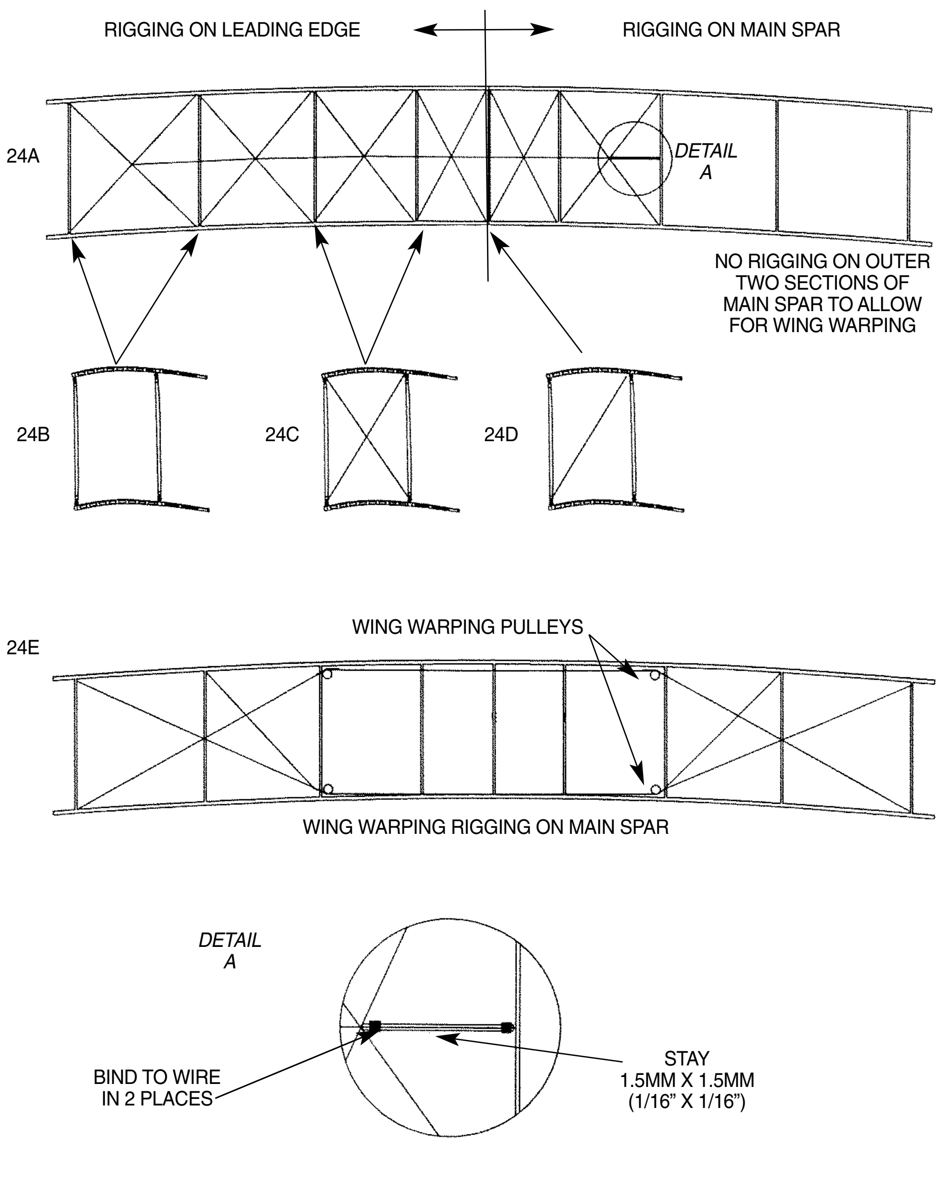
As you connect the wings, the top wing should either be touching the jig or just clear of it. In either case tie to the jig, but do not force into position.

The wing truss wires can now be connected as shown in Figure 24. Be sure each is taut as they hold the wing structure together and hold the wings in position. Loop the wire through the wing strut fitting, pull taught and put a small drop of cyanoacrylate where the thread goes through the fitting. When set, tie off and soak the knot with glue and trim the thread off flush with the knot.

The wires that control the wing warping are connected at the tips as shown in Figure 24. They are tied to the fittings as with the other wires.

Finally attach two wires to stabilize each propeller support assembly. The first runs from the rear joint of the support assembly to the lower center strut fitting on the main spar. The second connects the rear joint of the support assembly to the upper strut fitting on the strut just outboard of the assembly, on the main spar.

FIG. 24 WING RIGGING DETAILS–NOT TO SCALE



Most airplanes have a fuselage, the main structure that houses the pilot and engine and onto which everything else is attached. This is not the case with the Wright Flyer. The main structure, the wings, has already been completed and the remainder of the parts are connected to them. In this stage we will complete the landing skid, the elevators, the rudders and their support structures.

The landing skid

The landing skid did what its name implies. When landing on the soft sand at Kitty Hawk, North Carolina, the airplane skidded to a stop. Thus, there are no wheels on this structure.

The landing skid is shown in Plan 6 and Figure 25. It is basically built of pieces of stick wood. Build a left and right side. The only differences are that the long diagonal strut and the strap (WF-PE14) are lapped over the other pieces on the inside. The reinforcement at point B in Plan 6 is a 8mm (1/4”) length of self-stick brass tape on the outside of the skid. The reinforcement at point C is “U” shaped and wraps around as detailed in Plan 6. Note the sections of the struts that are chamfered on Plan 6.

Connect the two sides with the cross ties, made from 1.5x5mm (1/16” x3/16”) stock. Note that the front one has notches cut in it so that it can be mounted at the angle shown. Assemble landing skid to the bottom wing. It will fit in the assembly jig. Add the center brace.

There are four bracing wires on each side of landing skid connecting it to the wing. The front two go from points A and B on Figure 25, over the front of the leading edge spar and connect to the strut fitting on the 3rd strut as shown. The third strut is approximately 150mm (6”) from the center line of the airplane. The rear two wires go from Point C and D to the plate beneath the wing warping pulley on the main spar as shown in Figure 22 Points A-D on the Wright Flyer had small fittings fastened with bolts through the members. These can be modeled with pins cut short and inserted into the skid rail and tie the thread to these. If you don’t want to get this precise, glue the end of the threads to the nearest joint.

Elevator control frame

Details of the frame can be found on Plan 7 and Figures 26, 27 and 28. Before building the frame, if you want the elevators to operate, drill 2 small holes (<1mm (1/32”) dia.) part way through each WF-L17 from the back side where shown on Plan 7. The ends of short lengths of thread, used as hinges for the elevators, will be inserted into these holes. Using Plan 7 to insure alignment,

PLAN 6 LANDING SKID

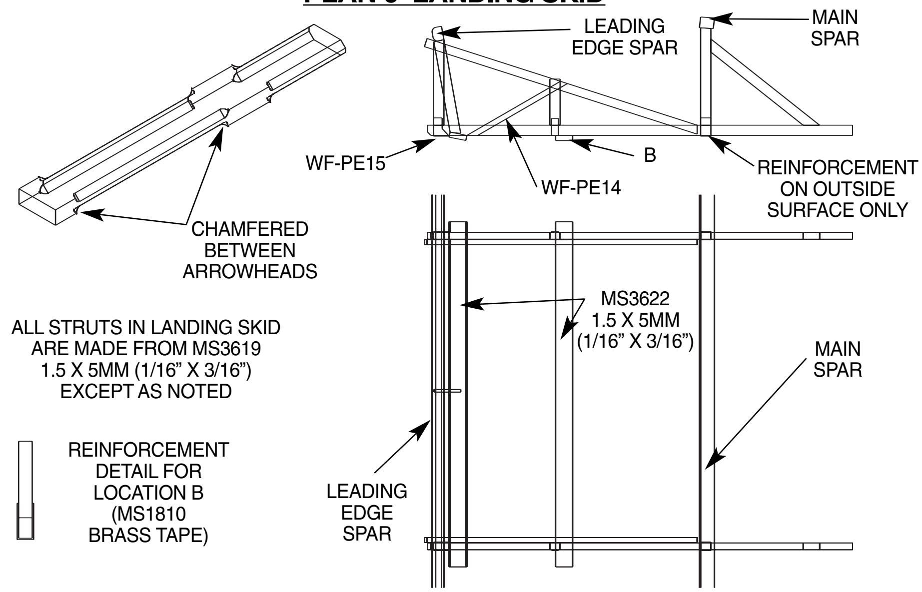


FIG. 25 LANDING SKID DETAILS AND BRACING

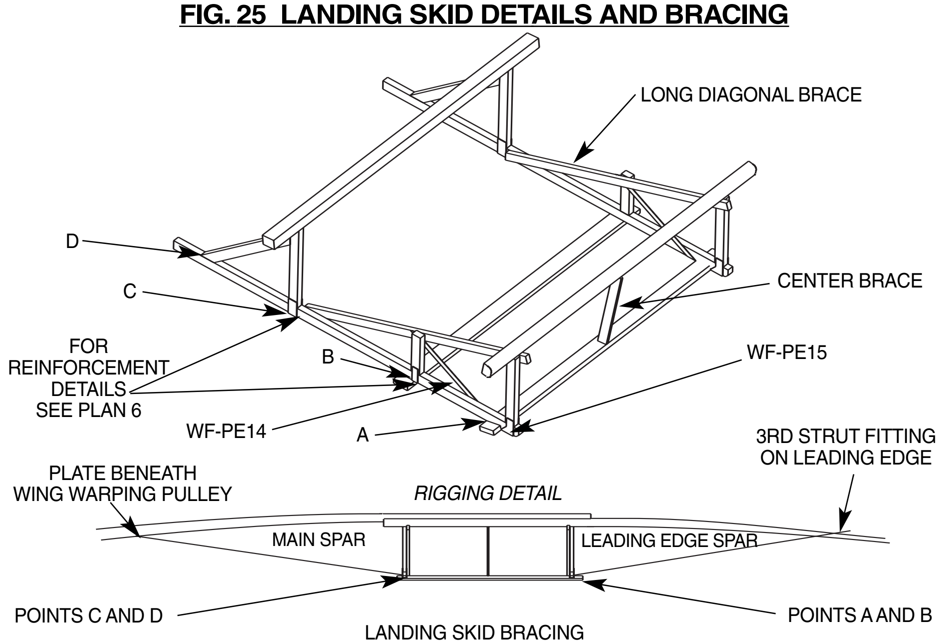
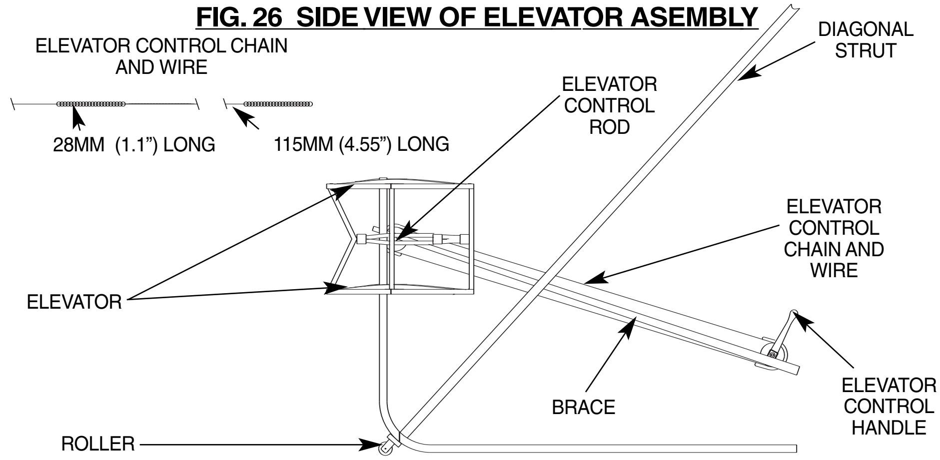


FIG. 26 SIDE VIEW OF ELEVATOR ASEMBLY



glue WF-L16 to WF-L17 for the two sides of the elevator control frame. Add the diagonal strut flush with inside of frame. Taper brace from 1.5 x re. Add brace to inside surface of diagonal strut and frame. Glue to diagonal strut, but DO NOT GLUE BRACE TO FRAME or you will not beable to get the elevators on.

Add the upper and lower cross ties as shown on Plan 7 and Figure 28. Add the roller to the lower cross tie. There are three rollers that are used as "wheels" during the launching of the Flyer. One is on the lower cross tie and the other two are on the launching dolly. The Wright Brothers used bicycle wheel hubs for the rollers. The roller is detailed in Figure 36. The axel 2.5 mm (3/32") dia. aluminum tube is 3.2mm (.125") long and is bonded to the front roller bracket, WF-PE12 as detailed on Plan 7 and Figure 26. The hub body 3mm (1/8") dia. aluminum tube is 2.8mm (.11") long and is bonded to the side plates. Thus, the hub can rotate on its axel.

The elevators

Details about the elevator are on Plan 8 and Figure 26-30. There are two, identical elevators mounted on the front of the airplane. They can be made operational on this model. Using Plan 8 as a guide, build each elevator from a leading edge WF-L13, trailing edge WF-L14, ribs WF-L12 and center spar. The outer ribs need to be trimmed to length shown. Before building, if you want the elevators to operate, drill small holes (<1mm (1/32") dia.) part way through the leading edge, trailing edge and center spar where shown in Plan 8. See details of this assembly in Figure 29. The ends of short lengths of thread, used as hinges, will be inserted in these holes.

The components of the elevator actuation mechanism are shown in Plan 8. Figures 26-29 show the details. Begin by making the lever arms from 1.5 x 2.5 mm (1/16 x 3/32) strip. Split it as shown in Plan 8 and wrap with thread as shown. Glue the lever arms on the elevator control rod as shown in Figs 26, 28 and 29. Cut the rod from 1.2 mm (3/64") rod 98.4mm (3-7/8") long. Glue the control pulley WF-L21 in place. Make the front and rear operating struts from 1.5 x 1.5 mm (1/16" x 1/16") stock. If you want the system to work, poke or dill a small hole in the end of each operating strut and glue in a short length of thread. The thread "hinges" are detailed in Figure 29.

Assemble the elevator and the actuation system as shown in Figures 26-28. Note that there are six rear operating struts, three on the trailing edge and three on the center spar, one at each tip and one near the centerline. Once the assembly

PLAN 7 ELEVATOR CONTROL FRAME

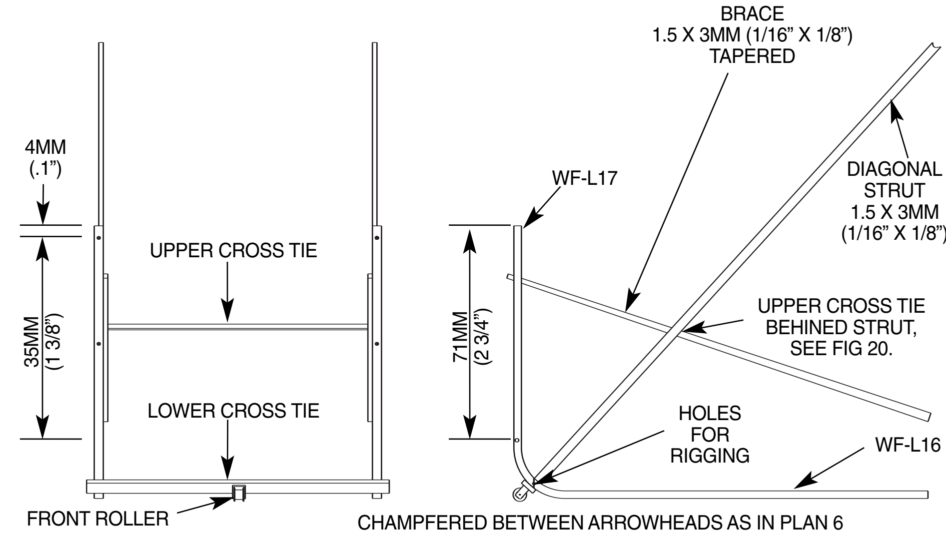


FIG. 27 FRONT VIEW OF ELEVATOR ASEMBLY

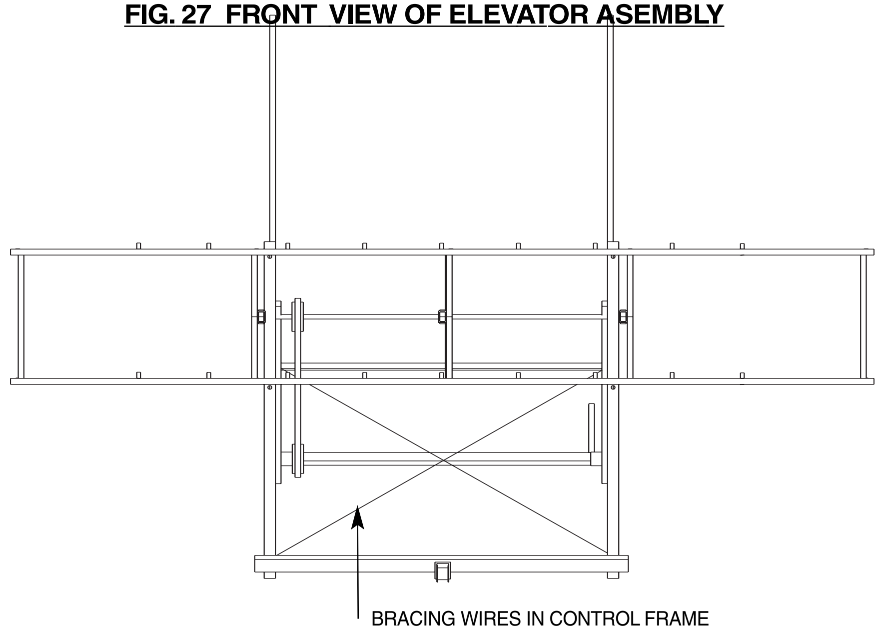
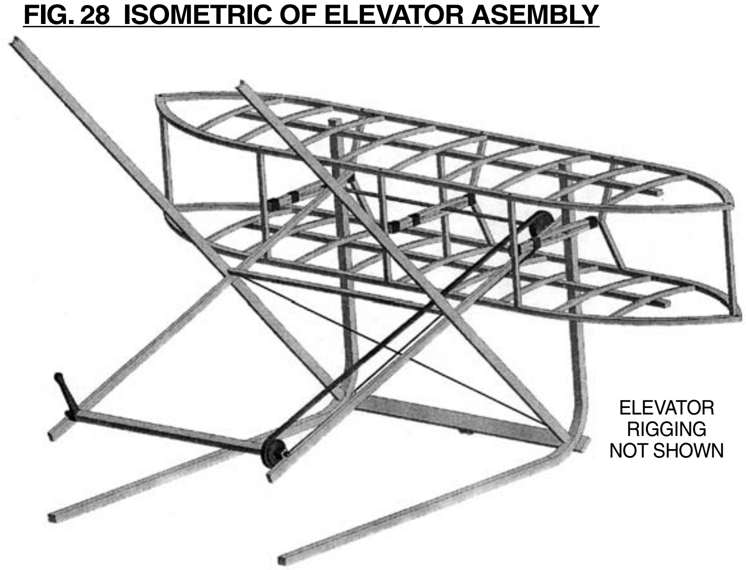


FIG. 28 ISOMETRIC OF ELEVATOR ASEMBLY



in Figure 29 is completed it should be mounted on the elevator control frame. Either the center spar is glued to the outrigger or, if motion is desired, short lengths of thread are used as hinges.

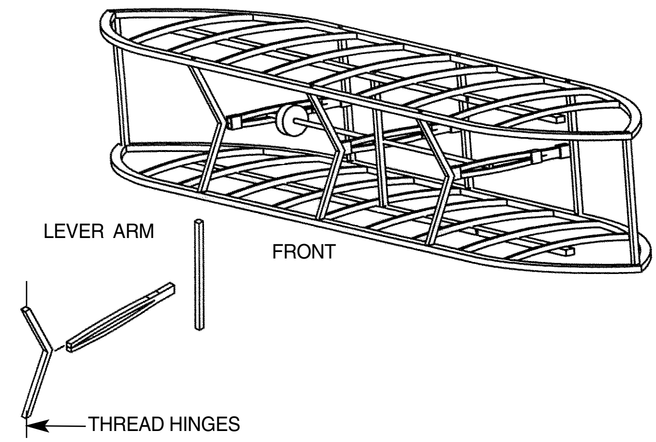
The elevators are actuated by the pilot's left hand moving a lever fore and aft. The assembly of the lever on its shaft is detailed in Figure 31. This assembly can be glued directly to the frame or made to pivot by using short lengths of straight pin as shaft and short pieces of tubing as the bearings, glued to the frame The pulley is connected by chain and wire (thread) to the pulley on the elevator control rod as shown in Plan 8 and Figure 26 and 27. The chains wrap around the pulleys with thread between.

Fasten the front elevator assembly to the landing skid and the leading edge spars of the wings as shown in Figure 32. This can be done while the wing structure is in the wing assembly jig, but then the jig will need to be destroyed to remove the model, or the model can be removed from the jig at this time.

The rear rudders

The rear rudders are a box like structure that pivots around a vertical axis (see Plan 9 and Figure 33. They are directly linked to the wing warping system. Build the two sides and connect with 6 spreader struts, and upper and lower spacers using the layout in Plan 9 and details in Figure 33. Before assembling the two halves drill holes in the upper and lower spacers for pins to act as pivots. Build the outrigger struts, two simple Vs and brace them with ferrules WF-PE16 and WF-PE17 as shown. These also serve as pivot points for the rudder. Assemble the upper and lower outrigger struts to the rudder. Attach the upper support to the top wing and the lower to the rear of the landing skids using pair of eyes as shown in Figure 33 and 34. Add bracing wire (#1) as shown and connect the rudder to the wires (#2 an #3) from the wing warping system.

FIG. 29 ELEVATOR ASSEMBLY



PLAN 8 ELEVATOR AND ACTUATION SYSTEM LAYOUT

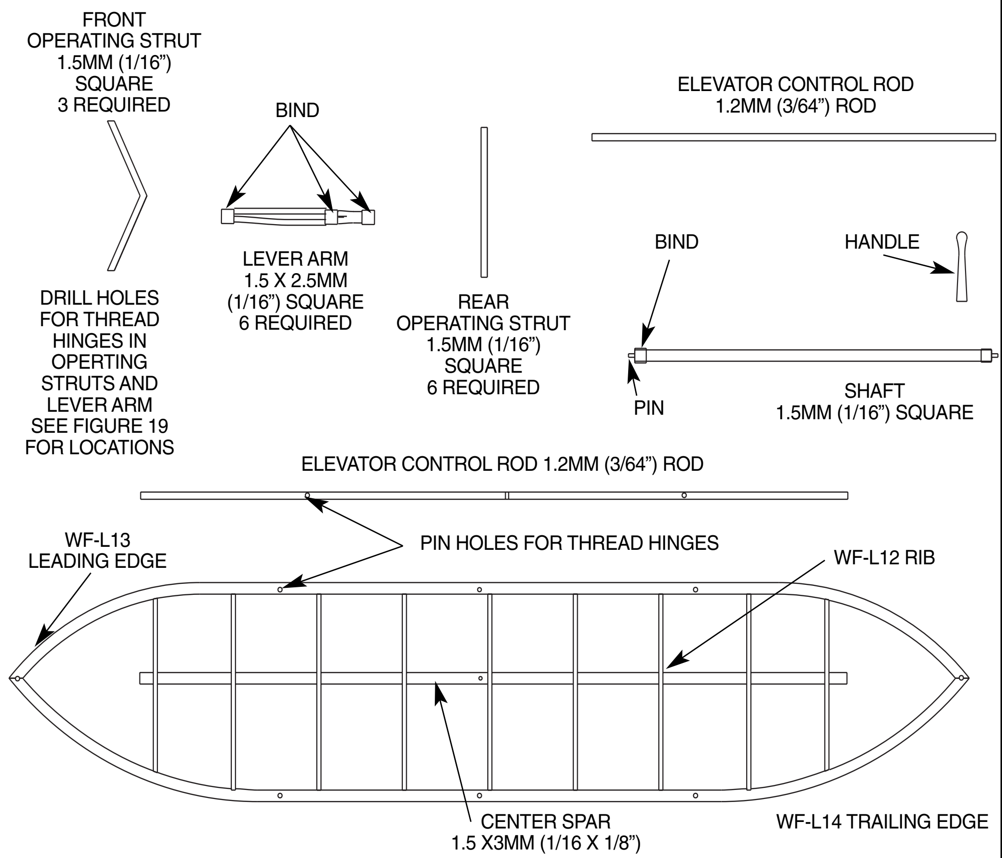


FIG. 30 ELEVATOR RIGGING

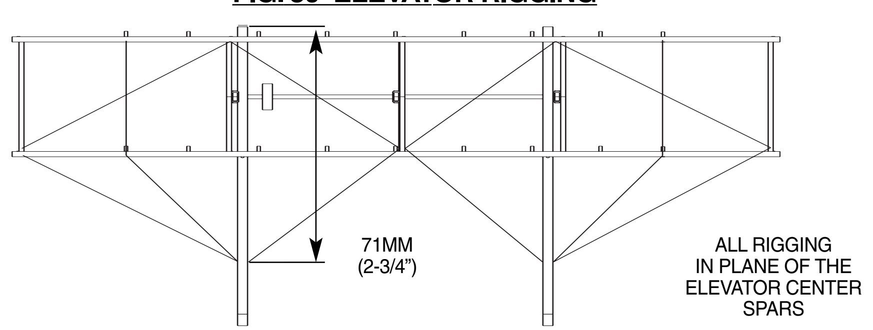


FIG. 31 ELEVATOR CONTROL HANDLE ASSEMBLY

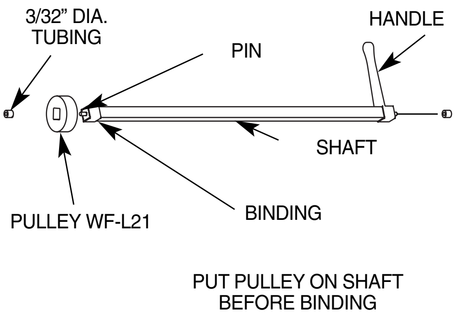
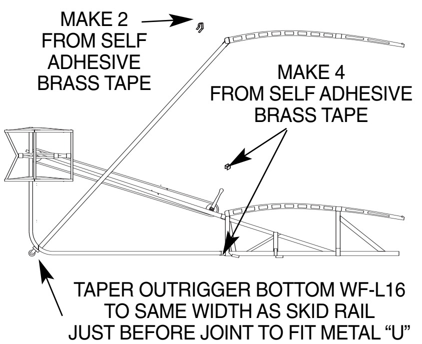


FIG. 32 ELEVATOR ASSEMBLY CONNECTION



PLAN 9 RUDDER

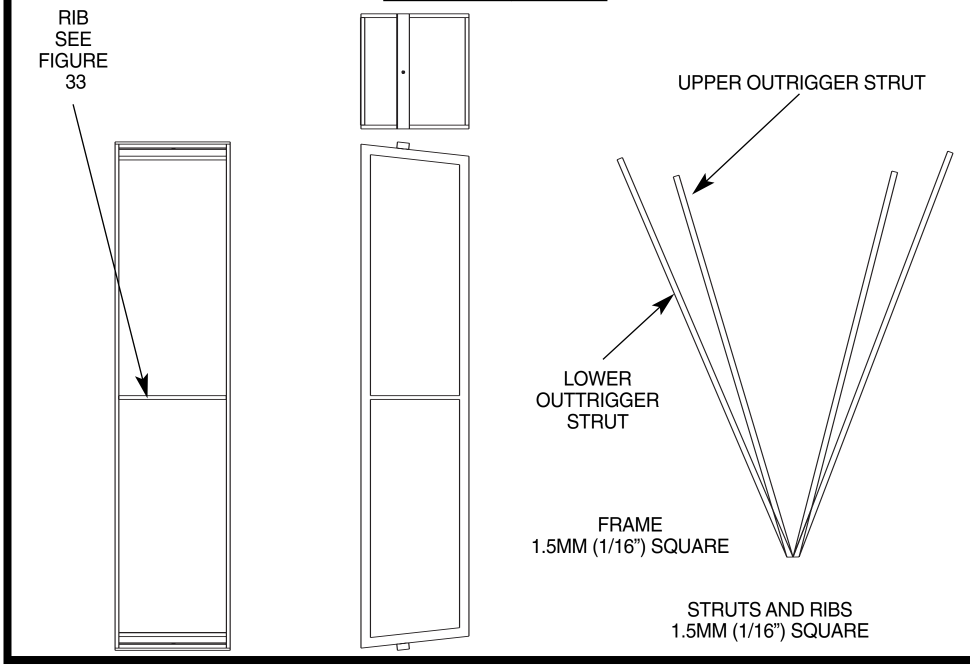


FIG. 33 RUDDER ASSEMBLY

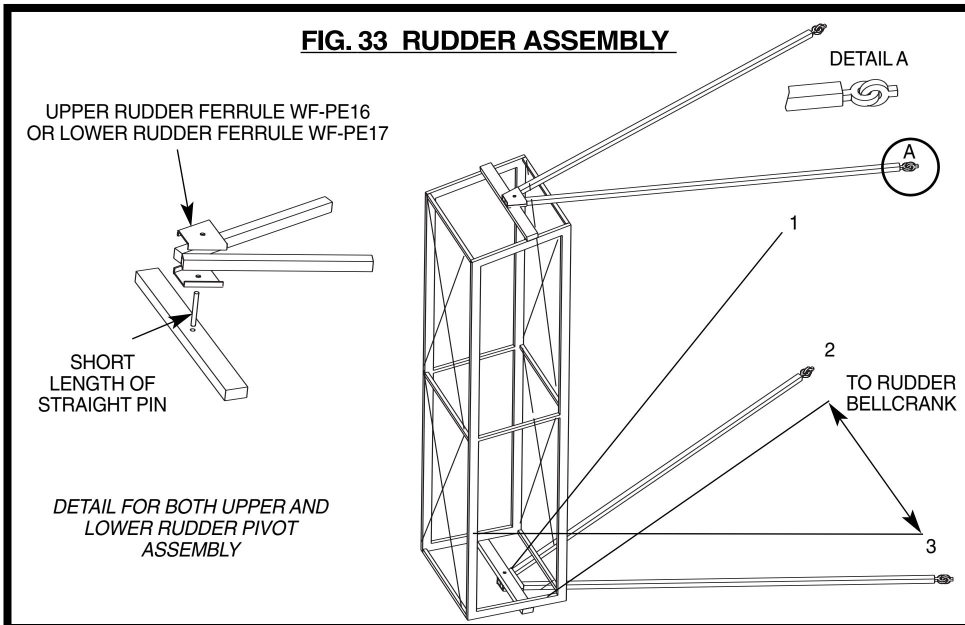
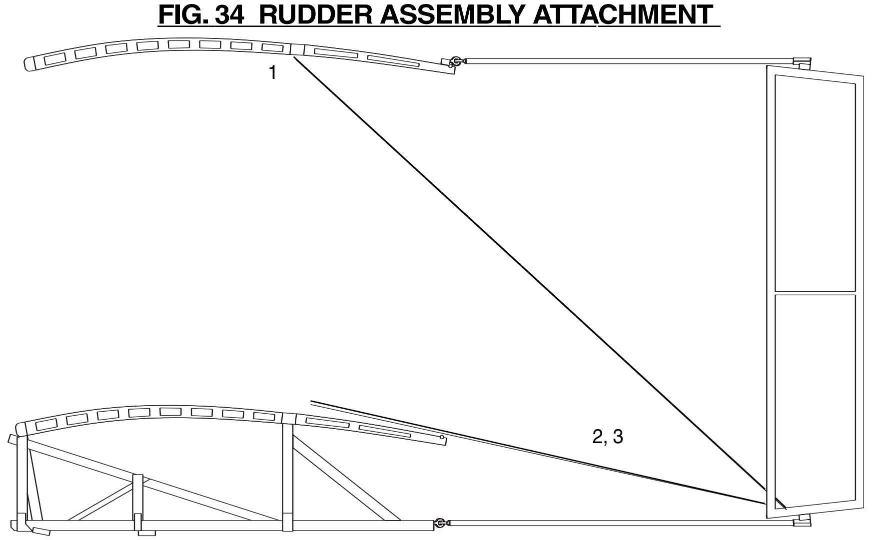


FIG. 34 RUDDER ASSEMBLY ATTACHMENT



STAGE 5: FINISHING TOUCHES

The Propellers

The propellers are built up of three laminations as with the original Flyer, Fig 35. Laser cut parts WF-L18 – WF-L20 are glued together to make both propellers, one left handed and the other right handed. Laminate by inserting a piece of rod through the holes in the three pieces and then aligning the flat center sections of the laser cut parts. Check that the laminates fan to a total tip width of 12.5 mm .5 in). Clamp the sections together well so the seams are tight. Carve the sections as shown in the figure. Sand smooth and add cloth doublers at the tips as shown. Soak the doublers with glue to fill pores in fabric. Sand lightly. Paint the propellers light gray. Add the propeller mounting plate (WF-PE13) to the forward (front of the airplane) side of the propeller. Add bracing wires to stablilize the propeller supports as shown in Figure 36.

Mount the propellers so that, from the front view, the right propeller rotates clockwise to push the airplane and the left turns counterclockwise. Glue the propellers on the shafts so that they are at 1:00 as shown on the box photograph. Paint the nuts (WF-B31) dark gray or black and glue them on the shaft with the washer aligned with the propeller.

Launching Dolly and Track

The Flyer sat on the launching dolly and the roller under the elevator control frame for takeoff. As the airplane accelerated forward the dolly and roller rolled on a wooden rail. The rail was in sections and could be easily moved so that takeoff was directly into the wind. In the famous photograph of the first flight, Wilbur is seen running at the tip of the wing to provide balance until sufficient airspeed was attained.

Details for the dolly and rail are shown in Plan 10 and Fig 37. The main beam of the dolly is laminated between the two side plates (WF-PE18). The rollers are made as described in elevator control frame instructions with the axel bonded to the side plates. Cover the rail top surface of the rail with brass tape

FIG. 35 PROPELLER DETAILS

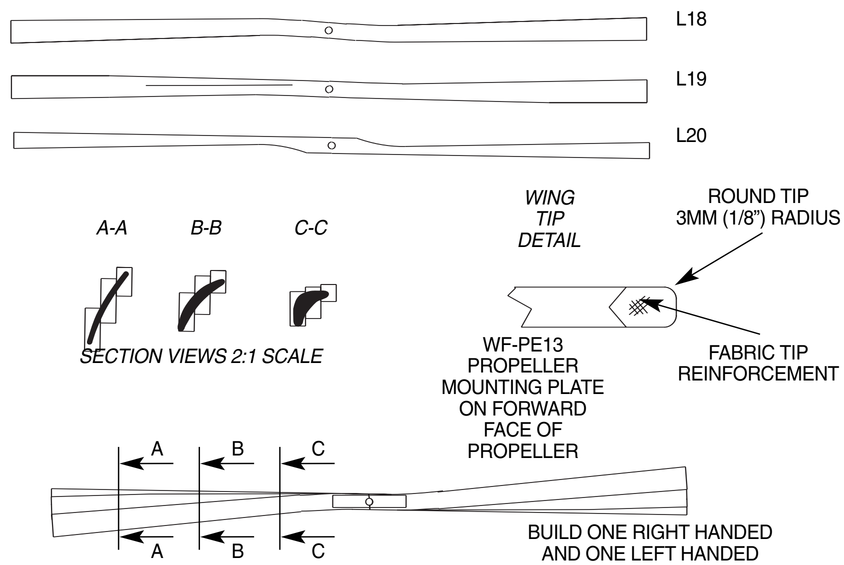
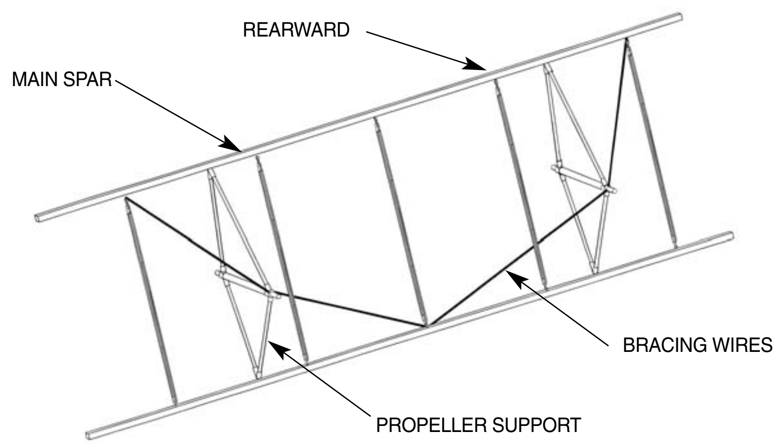


FIG. 36 PROPELLER SUPPORT RIGGING



PLAN 10 LAUNCHING DOLLY LAYOUT

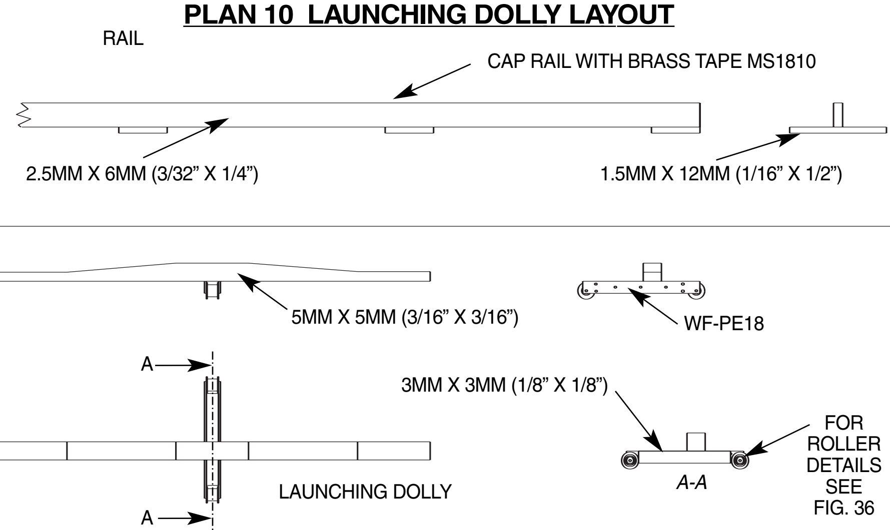
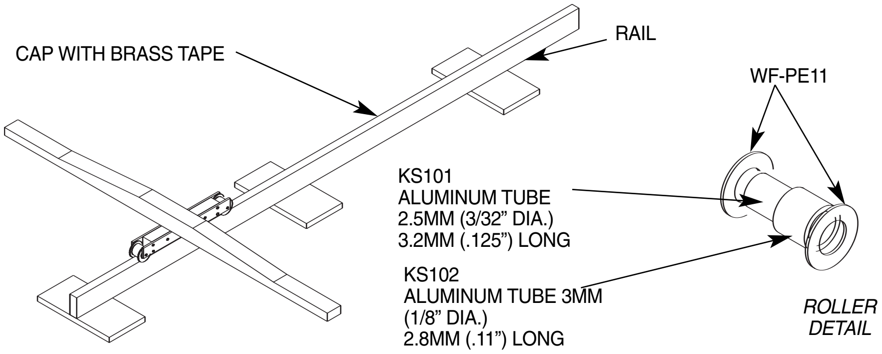
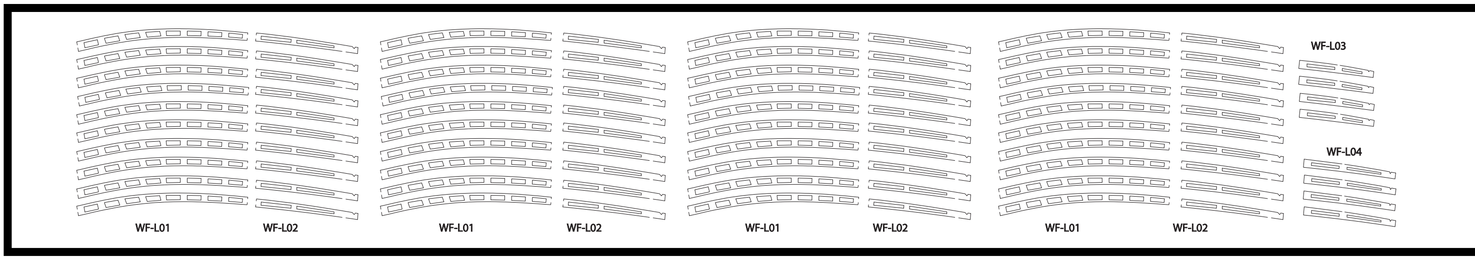
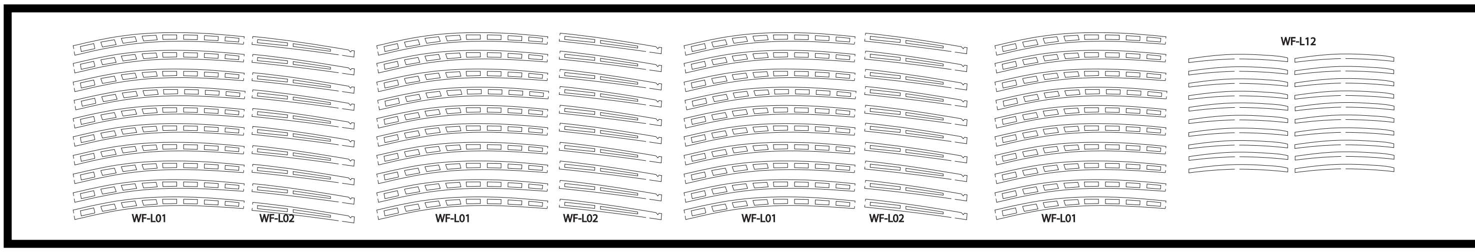


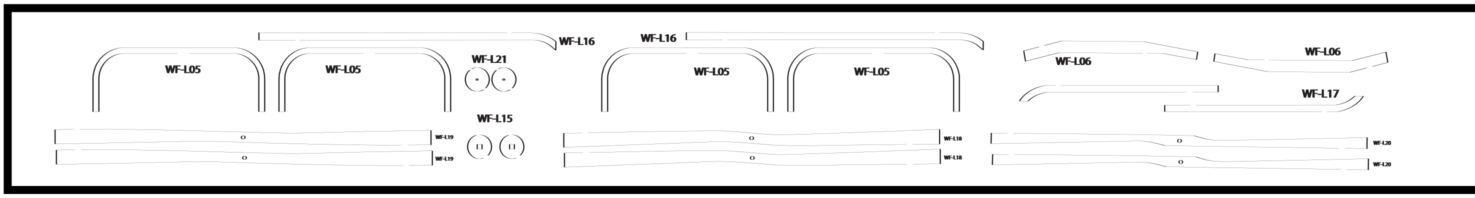
FIG. 37 LAUNCHING DOLLY

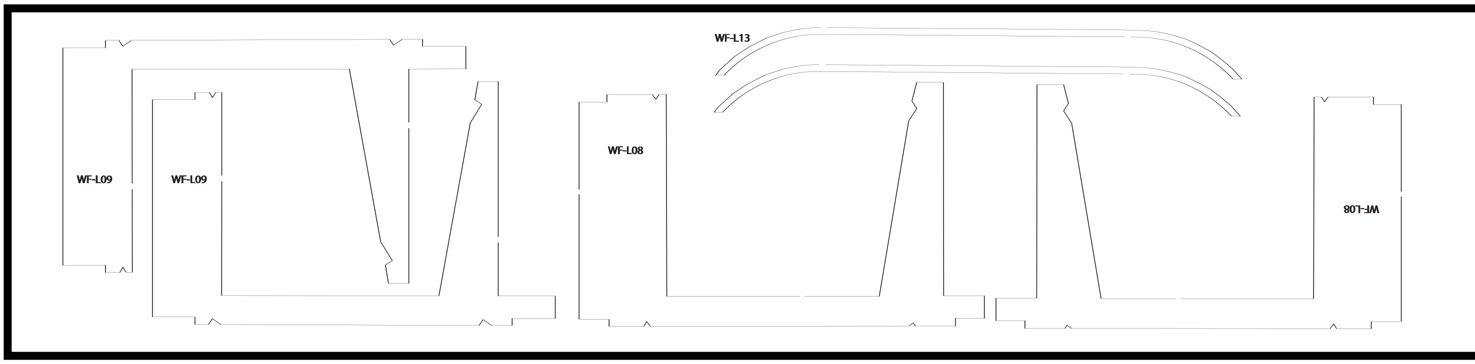


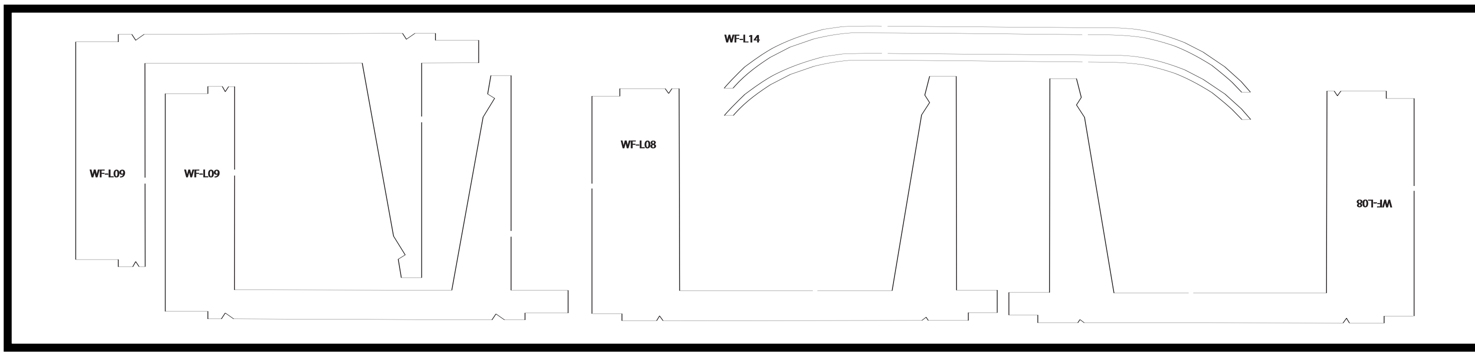
APPENDIX A : LASER CUT WOOD PATTERNS

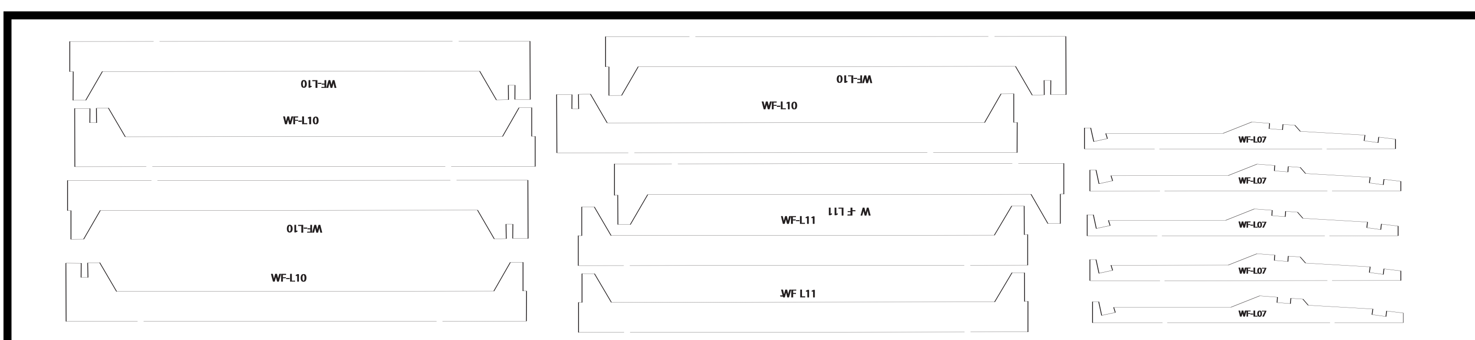




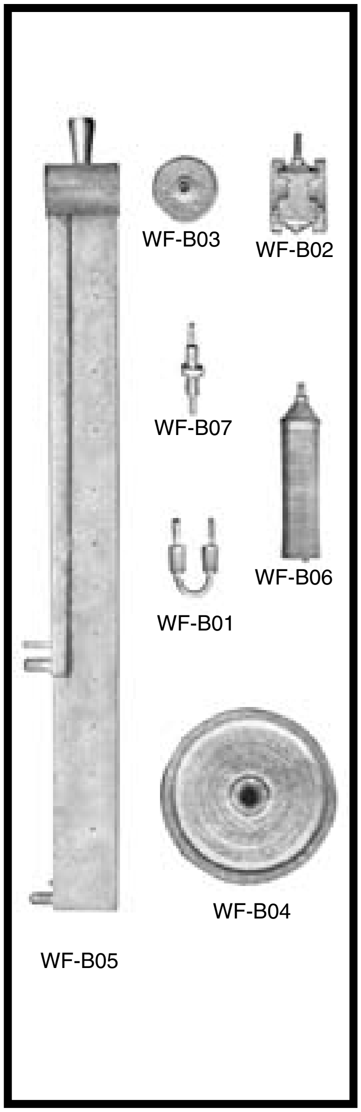


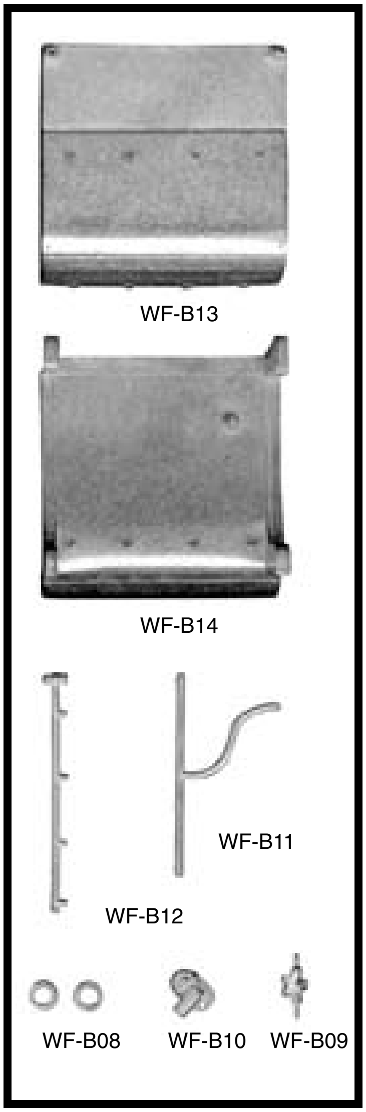


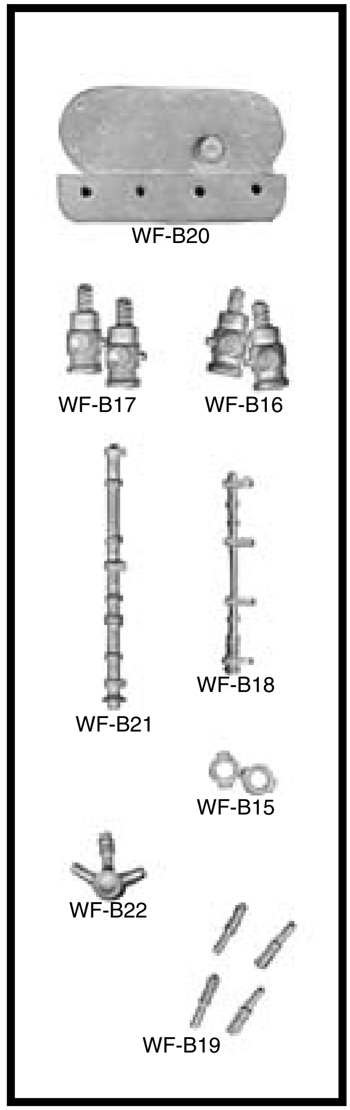


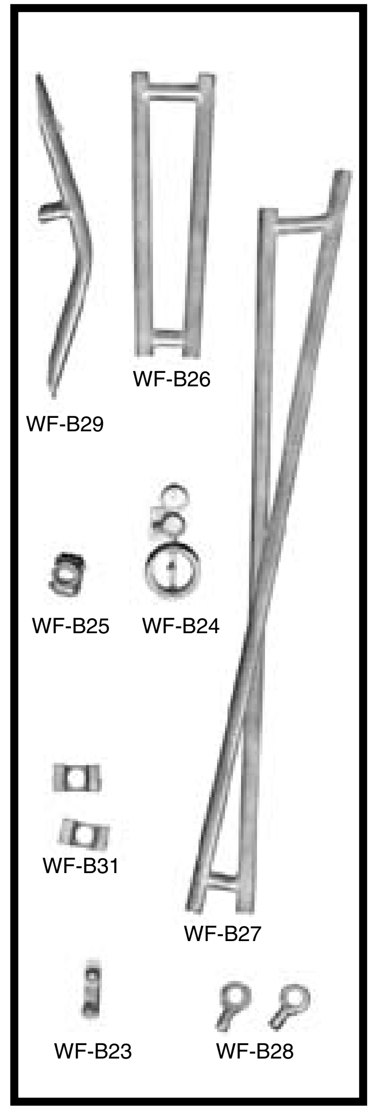


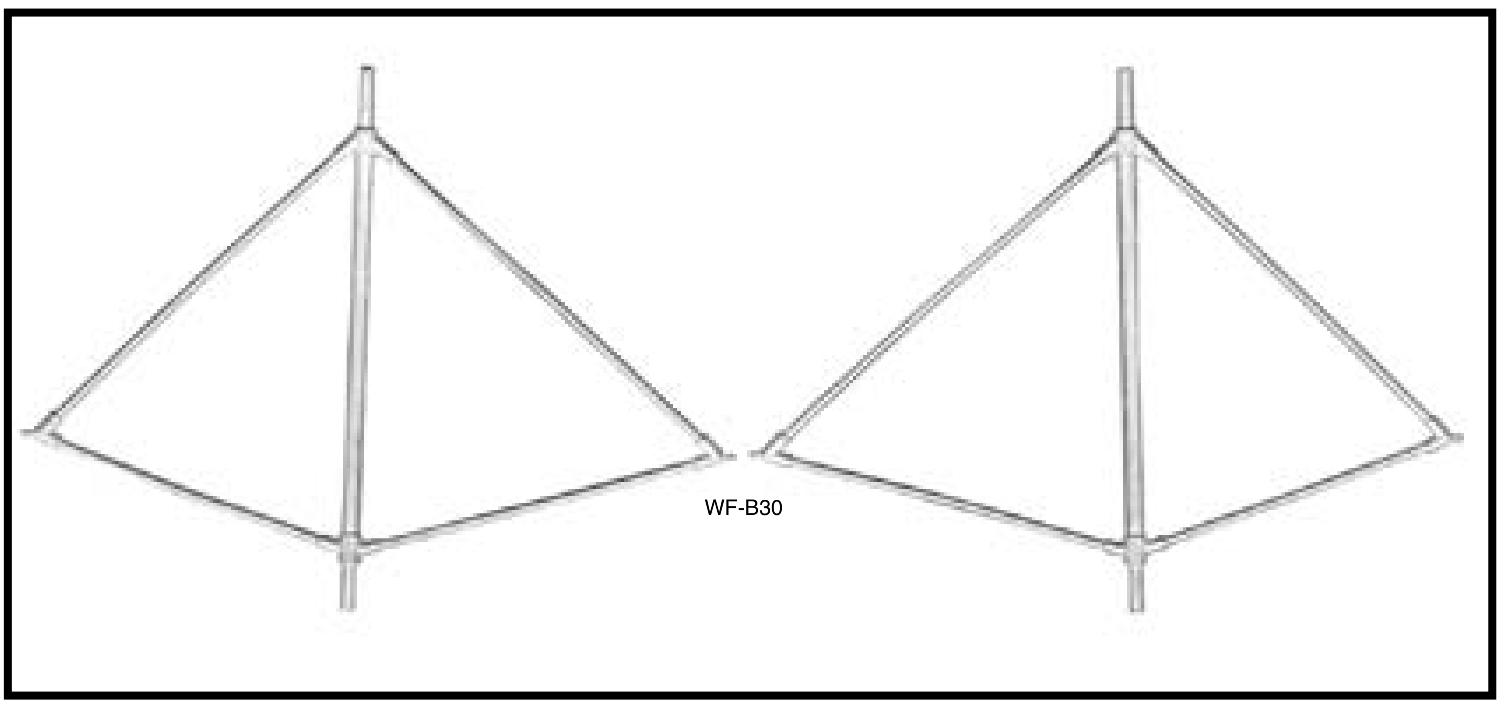
APPENDIX B : BRITTANIA METAL PARTS

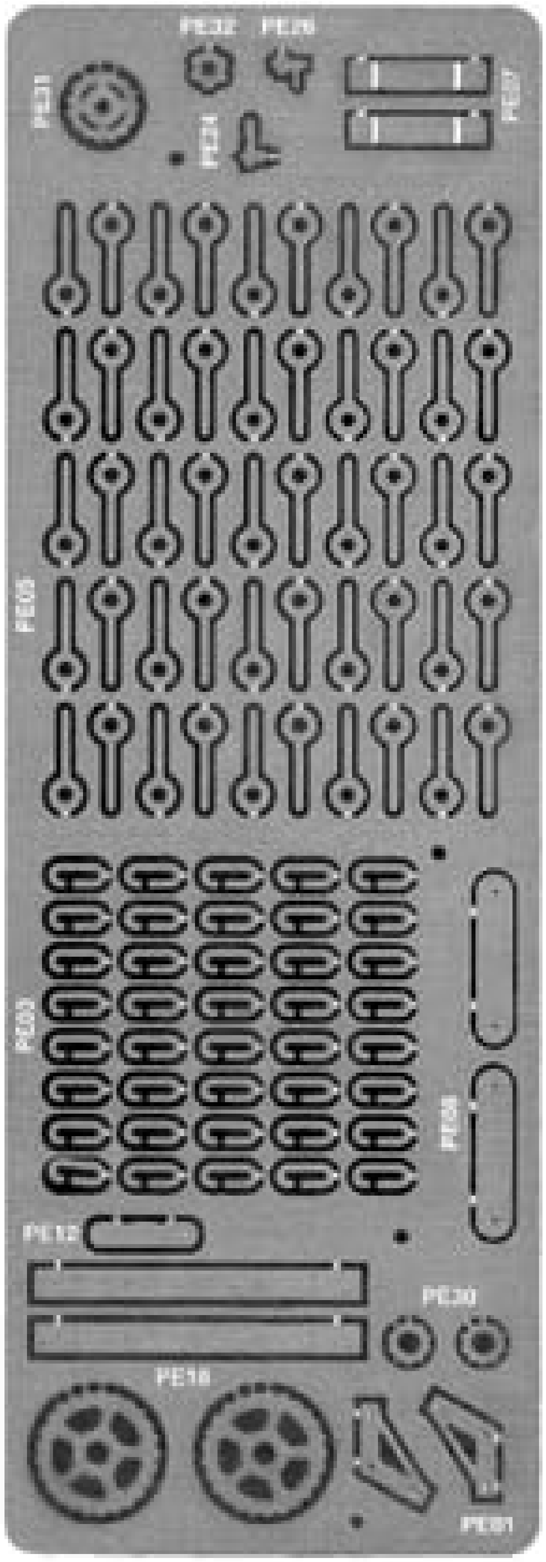


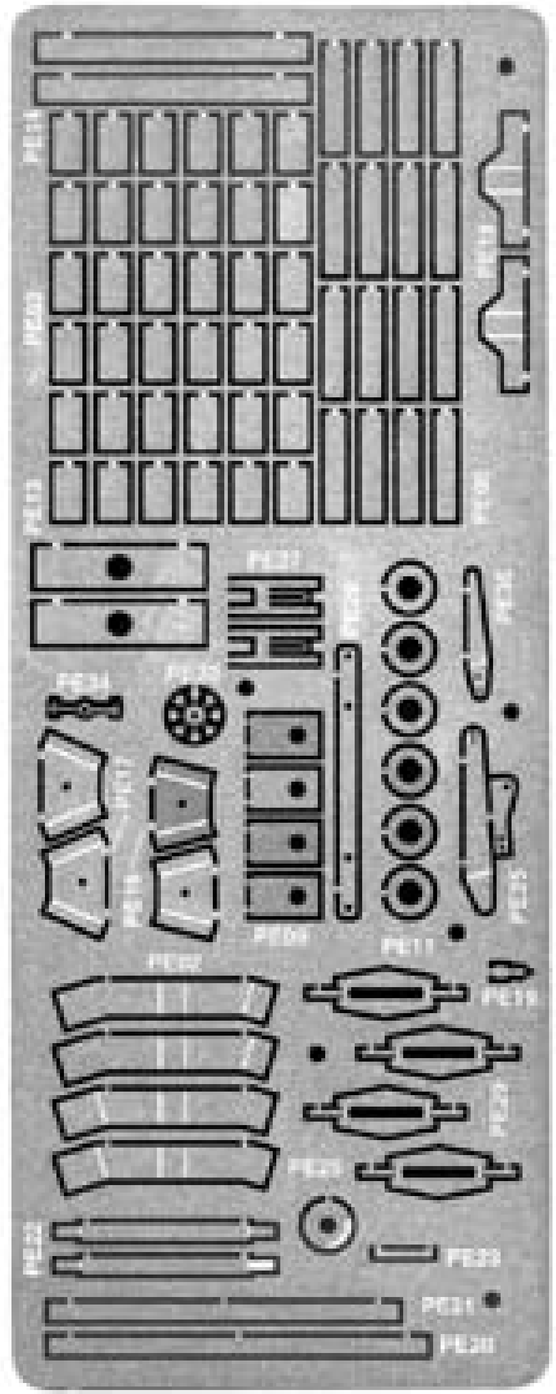












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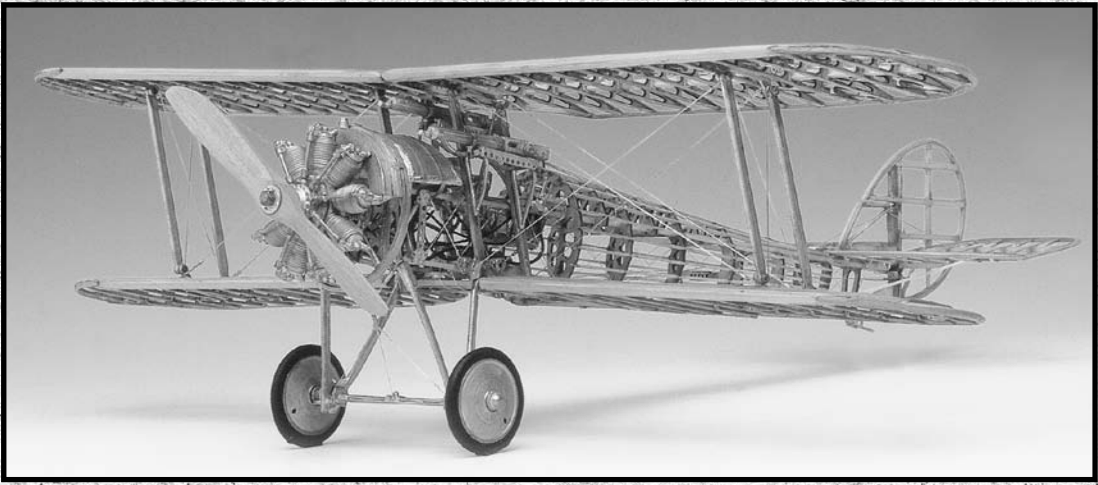

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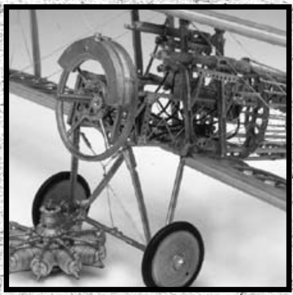

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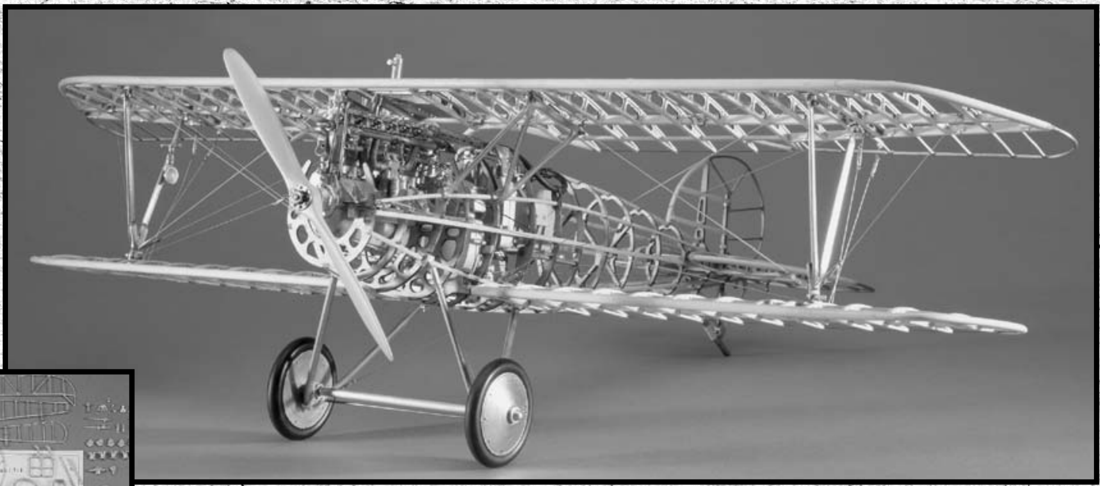

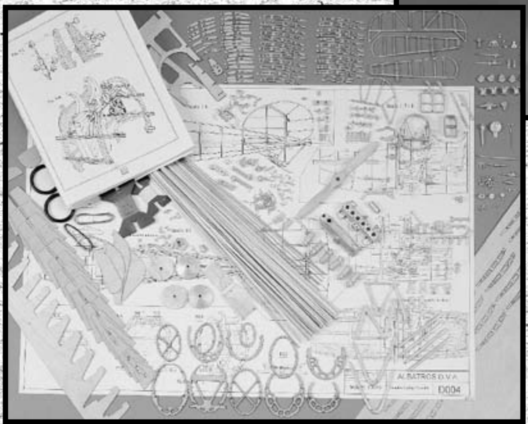

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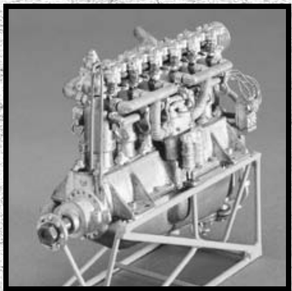

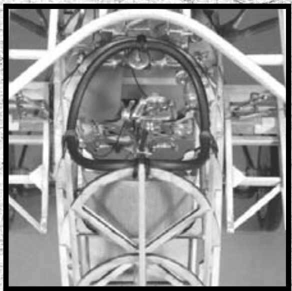

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