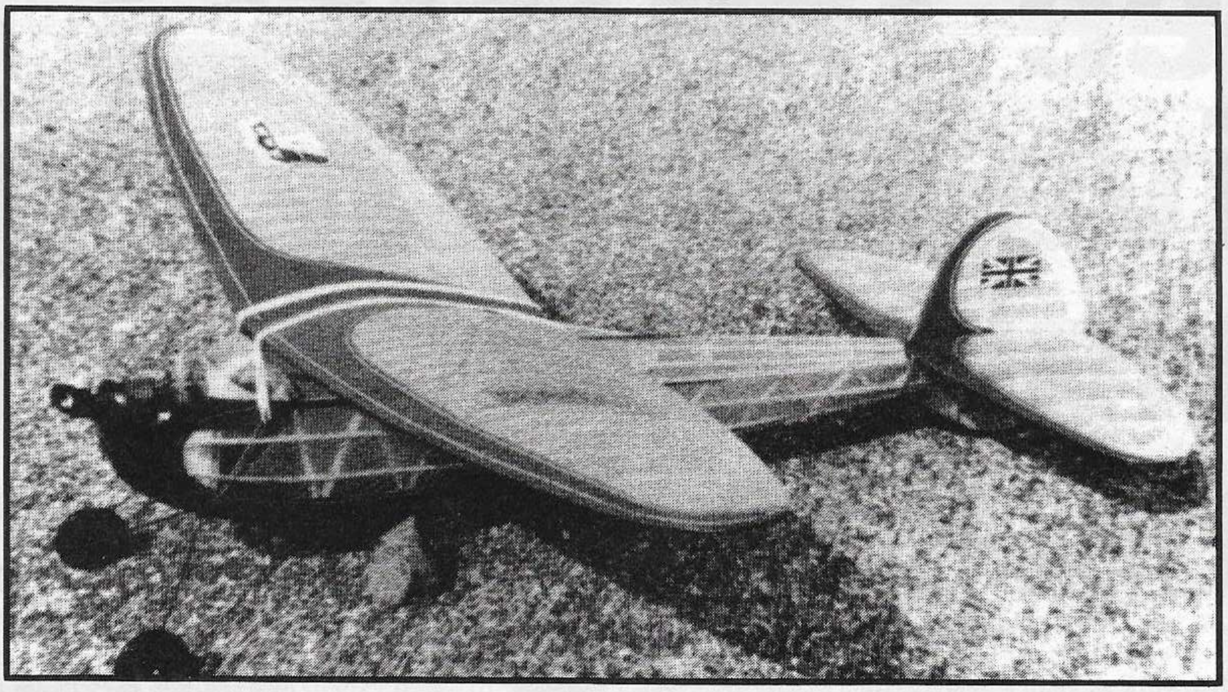


OLD TIMER SPECIAL

Two OT aircraft featuring the famed Murry/Ritz wing. The "Answer" was one of M.A.N.'s top designs in 1940.

by Walter A. Musciano

WING STRUCTURE and airfoil section are the heart of any free-flight model design. During the second half of the '30s, model aircraft designers began to revise their thinking about airfoils. In an effort to combine fast climbing with low rate of sink gliding, the long-popular Eiffel 400 and RAF 32 were gradually being replaced with NACA 6409, Gottingen 81, Gottingen 417A, and similar airfoils. The trend was heading toward single-camber or single-contour airfoils, in which the lower camber would be virtually identical with the upper camber. The basic problem with single-contour airfoils is the absence of depth or thickness which tends to give the wing less structural rigidity than the thicker airfoils, especially in torsional loadings. Some recent U.S.S.R. free-flight and glider airfoils again resemble the single-contour designs studied in the '30s.

In 1937 one of the many famous members of the "Brooklyn Skyscrapers" model plane club developed a successful single-contour wing. Gordon "Scotty" Murray claimed to have gotten the nucleus of this idea from a Chicago modeler, Jerry Ritz, and Scotty called it his Ritz wing. However, Gordon Murray developed the wing, aerodynamically and structurally, to such perfection and used the wing so successfully that it has always been called the "Scotty Murray wing" or airfoil. He applied very sound engineering principles and came up with a winner:

1. He increased the camber curvature for increased lift and to form a deep triangle between the high point of the camber and the leading and trailing edges for greater strength.

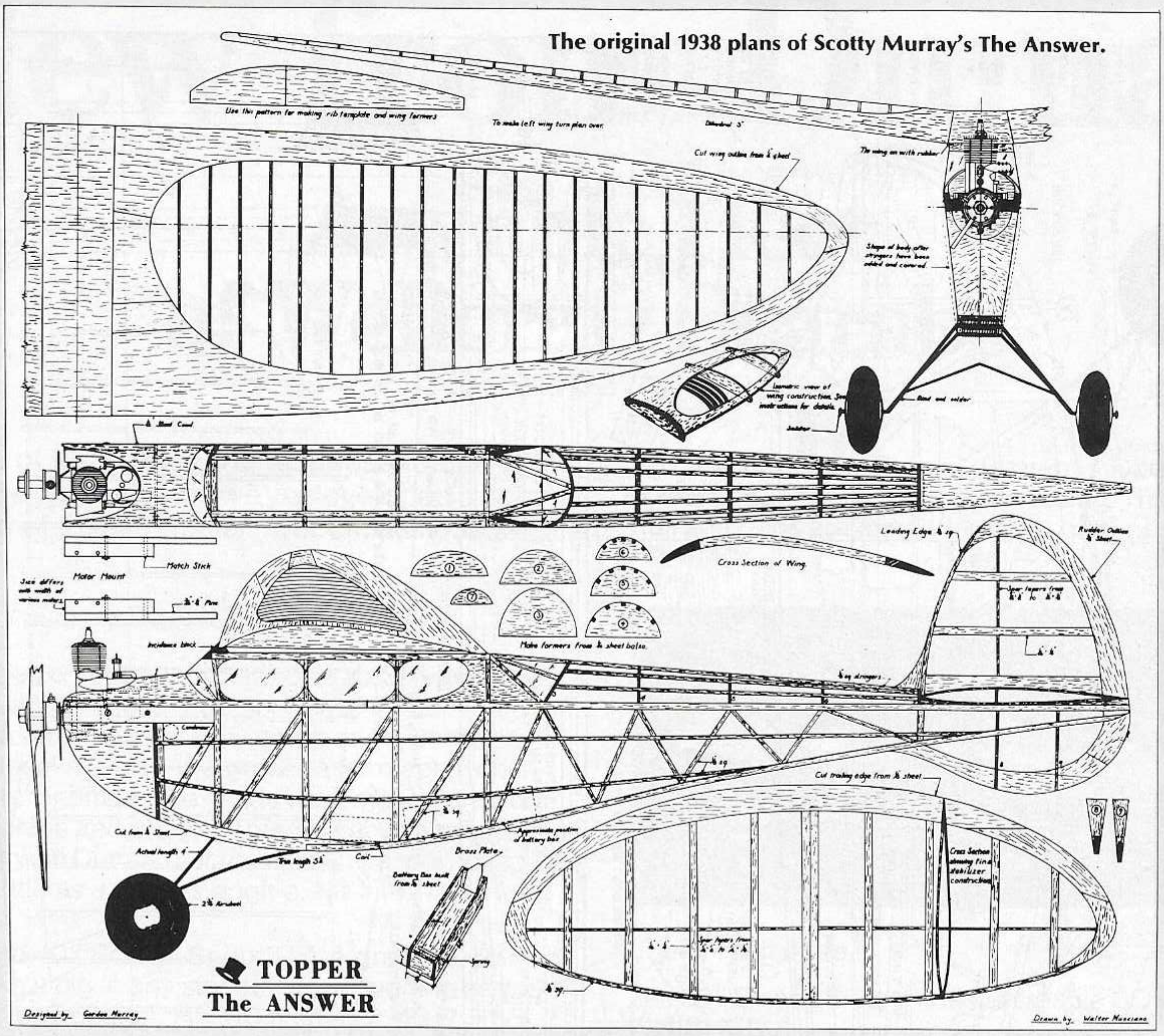
2. With an airfoil so thin that it could not accommodate spars, Scotty applied the hollow spar theory that the greatest strength of a cross section is found on its perimeter. He made his wing from thick, soft, sheet balsa and cut away the center for ribs and covering, leaving the strength to the perimeter.

3. Aerodynamically and structurally, an ellipse is the perfect shape for a wing. This is normally avoided like the plague by model builders because of the difficult design and construction problems it presents. Murray overcame these problems with his novel wing construction, in which the planform could be cut into any desired shape, and with his constant-thickness airfoil the various chord lengths posed no problem. So Scotty made his single-contour wing elliptical in planform.

4. The ideal dihedral shape is also an ellipse, but the complex construction required again makes it prohibitive. Polyhedral is an attempt, using conventional construction, to duplicate elliptical dihedral. As Gordon's flying buddies, including me, began using Ritz/Murray wings, it was noticed that as the covering pulled tighter due to the sun, etc., the dihedral increased somewhat and the wing curved gently, resembling an ellipse. This observation started a series of experiments that led to elliptical dihedral in Murray/Ritz wings. This will be described in Part II with my 1939 Hell Razor that also used the single-contour wing.

The Answer and virtually indentical Topper designs were Scotty Murray's most famous creations that used the single-contour airfoils. Both were consistent con-

The original 1938 plans of Scotty Murray's The Answer.



test winners, a fact he attributed to the wing design. The climbing ability of these designs was a vast improvement, but was still not really sensational because of the exceptional drag created by the single-contour airfoil. Yet, without pointing their noses skyward, the designs gained a very respectable altitude during the limited engine runs. The glide, however, was truly spectacular, with the slow gliding speed and low rate of sink afforded by the single-contour wing design. Even in still air on a cloudy day, Scotty's Answer kept circling in slow, lazy circles over Long Island long after the conventional designs had landed!

The Murray/Ritz wing had received considerable attention throughout the aeromodeling fraternity and Gordon Murray continued to perfect the single-contour wing until war erupted in Europe in the Autumn of 1939. Gordon was Scottish and when the situation appeared desperate for Britain after the fall of France, he felt the need to go to the aid of his country. Scotty joined the Royal Canadian Air Force. By the time he had completed his fighter pilot training, intense aerial activity had spread to the Mediterranean and Gordon found himself flying a Spitfire, defending the island of Malta. During the fierce air battles over that island bastion, Gordon's plane received a fatal hit and he crashed to his death. Hero, gentleman, exceptional friend, and most talented model plane designer, Scotty Murray will forever be remembered as an outstanding member of the human race.

Murray used sound engineering principles and produced a winner.

With the advent of Pearl Harbor, Scotty's remaining buddies, including Maurice Schoenbrun, Sal Taibi, Leon Shulman, myself, and many others, went on to serve our country and by the time modeling activities were resumed after the war, the Murray/Ritz wing was virtually forgotten.

Murrays' designs became famous during his lifetime and he soon needed an inked drawing of his Topper/Answer design, but could find no ink draftsman among his flying buddies until I volunteered to do the job. As the youngest member of the group, I considered it an honor to prepare the drawing for this modeling great. After serving its purpose, the drawing was returned to me and I still have it as a prized possession, although tattered and moldy. This 1938 antique drawing has been cleaned up and is presented here as a curio and for the benefit of the modeler interested in antiques. A new drawing has also been prepared and is presented here, much amplified in scope for those interested in building Scotty Murray's Topper/Answer.

CONSTRUCTION. The engine mount is very unusual and merits description. During the late '30s, the Brooklyn Skyscrapers devised and successfully used a breakaway engine mount. The conventional engine mount hardwood pieces to which the engine was bolted did not extend into the fuselage as in normal

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practice, but were only a couple inches long. These were attached to hardwood engine mount bearers which were built into the fuselage structure. The mounts were held to the bearers with a 3/32 or a 1/8-inch bolt and a wooden matchstick. The theory was that in a hard vertical-propeller landing or a minor crash, the matchsticks break and allow the mounts to pivot on the bolt, thereby saving the model and/or engine from serious damage. It works too!

The basic fuselage is of fairly straightforward side-frame construction, except that the side-frame does not extend above the main longeron. The engine mount bearer should be included as part of the side-frame structure. When the cement is dry, lift the side-frame off the plan and turn it over so it faces the opposite direction. Now, construct the other side-frame atop the reversed previously-completed frame. Separate when the cement is dry. Join the side-frames together with the 1/8-inch square diagonal braces facing the outer edge of the 3/16-inch square longerons, as shown in the fuselage sections.

Begin joining the fuselage at the rear by cementing pieces "J" and "K" between the longerons and cementing the fuselage sides together at the rear after they have been bevelled as shown. Hold the side together at the rear with rubber bands or clamps.

Now, cut out and cement the crossbraces between the fuselage sides, progressing forward. Note that the fuselage sides are not parallel when viewed from the front and therefore the bottom crossbraces are shorter than the upper crossbraces. See the typical sections and notice the line of the lower longeron on the fuselage top view. Continue installing the crossbraces up to the bulkhead, which must be very firmly cemented to the engine mount bearer, main longeron, forward upright, and lower longeron. Recement all joints. Sand the fuselage top with a sanding block to flatten the main longeron as shown in the fuselage sections.

Add the cowl, ventral fin, cabin, and turtledeck now. Construct the cabin sides side-frame fashion and cement them atop the main longeron with crossbraces between the cabin sides at the top. Add the turtledeck formers and notice that former "D" is tilted aft. Cement the stringers to the formers. Cút out and cement the 1/8-inch balsa ventral fin pieces to "H," "J," "K," and the longerons at the rear.

Cut the cowl cheeks from 1/4-inch balsa and firmly cement them to the bulkhead and engine mount bearers. The cowl front grain must run spanwise to facilitate bending. Notice that the cowl front is cut away to clear the engine crankcase by an ample margin. The upper cowl is 1/16-inch balsa bent over former "B" and cemented to the former and the main longeron. The upper cowl must be cut away for access to tank filling, engine needle valve, and air intake tube for choking. Add fuselage stringers by cementing to all uprights and crossbraces, lower longeron, and bulkhead. Sand the entire fuselage with a block and re-cement all joints.

Bend the landing gear from three pieces of 1/16-inch wire; two main struts and a spreader. Bind together with fine, soft wire and solder. Bind the landing gear assembly to the double crossbraces with strong thread and cement well. This can be wrapped with strips of silk instead of thread, if desired, and well cemented.

The tail surfaces used by Scotty had cap strips but no ribs. This provided a light, strong structure that could be used effectively only if the airfoils were symmetrical. First, cement the 1/8-inch sheet balsa trailing edge and tip pieces together and then cement the tapered spar to this assembly. At this point it is important to mention that the rib strips should be cut in pairs to insure that the top and bottom strips are indentical in length.

One approach to the tail construction is to prepare a jig to prop up the trailing edge and tips as the rib strips are cemented in place. I prefer the method used by Scotty, which is a hand-held assembly: once the trailing edge, tip, and spar have been cemented together, the strips are installed in pairs, top and bottom. Start with the centerline, which requires two pairs of rib strips cemented to each other. Cement each pair of rib strips together at the rear with the strips forming the approximate angle of the airfoil. As the cement begins to set, slip the joined strips onto the spar, one above and one below, just enough for the cemented apex to touch the trailing edge. Cement the joined strips to the trailing edge and move on to the next pair.

When the cement has thoroughly dried, apply cement to the strip/spar contact and the forward inner surface of the strips. Press the forward end of the strips together, making sure the ends are in line with each other, and hold them together with straight pins or clothespin clamps until the cement is dry. Now, bend the leading edge from tip to tip following the rib strips and cement firmly in place. Hold with straight pins until the cement is thoroughly dry. Repeat the process for the fin structure. Re-cement all joints and, when dry, trim the trailing edge, tips, and leading edge to shape, and sand with a sanding block. Cement the fin to the stabilizer after both have been covered and doped.

The wing construction is next and is much easier to build than the conventional free-flight wing. Start by accurately tracing and cutting the wing outline pieces to shape from soft, but not pulpy, 1/4-inch sheet balsa. Cement the pieces very securely to each other to form a left and a right panel. Note the grain direction. While this is drying, the airfoil pattern, wing jigs, and formers can be accurately traced and cut to shape. Use the airfoil pattern to trace the ribs. All ribs are made from the same size. Be sure the draw the wing datum line on every rib, the airfoil pattern, the wing jig, and the wing former, as well as on the assembled wing outline. All ribs are cut from 1/16-inch balsa and are 1/4-inch high with parallel top and bottom camber lines. Pin all the ribs together and sand them until uniform and smooth, using a block.

Mark off the rib locations on the wing outline and cut the notches slightly smaller than 1/16-inch wide so the ribs fit snugly. The wing must be assembled on a flat board or workbench free from warps or bends. It is not necessary to build each panel over the full-size plan, but it is necessary to draw the wing datum line on the work board to insure proper rib alignment. Once the line is drawn, firmly attach the three, or more if desired, wing jigs to the building surface. I always cement the jigs to the work board. Be sure to align the datum lines.

Now moisten the wing panel with several applications of hot water, especially the root and tip areas that must bend the most. Lay the wet wing panel over the jigs and pin it in place, bending gently to follow the aifoil curvature. If the wood resists bending, don't force it, just apply more hot water with a cotton wad. Once pinned in place, allow the wing to dry overnight in a warm room. Leave it pinned to the wing jigs for the rib installation.

Each rib must be cut individually to fit the space into which it is to be cemented. Be certain that the datum line on the rib is aligned with the datum line drawn on the work board. With the wing outline pinned to the jigs, cut ribs to the proper length and slip them into the notches using plenty of cement. When the initial cementing has dried, all joints should be re-cemented. Remove the panel from the jigs when all is thoroughly dry and construct the opposite panel in the same manner.

While this is drying, cut the center section to shape and moisten it to help it bend, following the contour of the wing formers. Cement it firmly to the wing formers, holding it in place with pins until dry. Cement the wing formers firmly to the root of each panel. When dry, carefully fit the panels to the center section with the proper dihedral. This will require a bit of sanding of both wing panels and the center section. Use a large block wrapped tightly with medium sandpaper and sand a little at a time until the fit is perfect. The panels must be very securely cemented to the center section and when the initial cementing is dry, reinforce the joint, top and bottom, with strips of crinoline cloth well soaked with cement. I tried this and it proved very strong. No mishaps due to weak joints were experienced. With today's glass cloth and resin, this joint can be made indestructable.

Using a sharp knife, trim the wing leading and trailing surfaces to the shape shown in the typical airfoil on the drawings. Sand the entire wing using a block. The Murray/Ritz wings were generally silk or Silkspan covered. It is important to cover the entire wing and not only the central area framework. This adds considerable strength and helps preserve the airfoil. The wing bottom should be covered first because the covering material must be made to adhere to every rib, and this is easier to do when the upper surface is still uncovered. The covering is doped in the conventional manner.

An alternate wing construction is described in part II. This covers my model of 1939 that used the Murray/Ritz single-contour airfoil wing. This design employed elliptical dihedral which could be applied to the Topper/Answer described here. The very important structural difference is the fact that the elliptical wing is made in one panel from tip to tip with no dihedral breaks. This produces a stronger and more aerodynamically efficient wing, and will be described in detail in next month's issue.

The fuselage cabin is strengthened with the sheet plastic windshield and windows. The windows should be applied in one piece on each side. This should be installed before the fuselage is covered.

The engine mounts must be cut to adapt the engine used to the bearers. This requires a bit of fitting because the mounts should fit the bearers "neat"—not tight, but not loose so they wobble. A drop of cement holds the wooden matchstick in the mount and bearer.

The finish is up to you. Most modelers stop at clear doping, but I never hesitated to add a little color dope trim.

Proper balance is achieved by moving the batteries forward or aft after the coil has been secured in place. The coil location is limited by the length of the high tension wire to the spark plug. The two intermediate or "C" size batteries can be installed in a sheet balsa box or in an Acme or similar battery holder.

Aerodynamically and structurally, an ellipse is the perfect wing shape.

Free flight adjustments are made by offsetting the fin/stabilizer assembly, adjusting the wing angle of incidence, and offsetting the thrust line down and to the right. Climb and glide can both be to the right or the climb can be to the right with glide to the left forming a large "Figure 8" when the engine stops and glide begins.

RADIO CONTROL VERSION. Radio control installation in the Answer is simple because of the cavernous fuselage. An R/C Answer will provide great fun with rudder only, however, I suggest both engine and rudder control.

R/C operation can be conventional with full control from takeoff to landing, in which case the light wing loading will make the design eligible for "schoolyard" flying.

Another pleasure-filled mode of operation is to take advantage of the slow gliding speed and low rate of sink characteristics of the Murray/Ritz wing. Power the model up to several hundred feet of altitude and stop the engine. Now, enjoy the graceful, silent, lazy circles of your Answer as it transforms into a glider. Kick the rudder now and then to steer the model into or out of thermals and to keep it overhead as you recline on the grass for a fun-filled afternoon.

For the sake of clarity, the caption on the plans indicates the following: Items which are necessary only for radio control are marked "RC" in a square; items which are necessary only for free flight are marked "FF" in a hexagon; and items which were installed on the prototype model in 1938 are marked "P" in a triangle.

The powerplant shown on the plans is the electric ignition engine used for the prototype free flight model in 1938. An R/C version powerplant can be of any modern glowplug engine from .09 to .15 cubic inch displacement. Of course, an ignition engine can be used for the R/C version, but it need not be as big as the free flight powerplant. In fact, why not use one of the fine electric motor flight systems for R/C?

The modifications required to convert from free flight to R/C are minimal.

The stabilizer should be firmly cemented to the fuselage instead of using rubber bands. A 1/16x1/2-inch stabilizer cap strip must be added to the bottom only on each side of the centerline cap rib to provide a wood-to-wood cementing surface with the fuselage.

A rudder post must be installed in the fin and a solid soft balsa rudder hinged to the post. Securely install a nylon horn to either side of the rudder.

R/C fuel tanks seem to be getting bigger and bigger and this fuselage can accommodate any tank suitable for the engine. Install the tank of your choice and run the fill, feed, and vent connection tubing as required.

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Install the R/C equipment and the control rods, which can be made from balsa and wire for the rudder and cable for the engine control. Be sure that the rudder has at least 30° travel each to left and right so the Answer can be spiraled out of a thermal when necessary. Check the control and it's off to the nearest open area for some flying fun!

Don't forget part II next month. Happy flying! ■