CONSTRUCTION MANUAL

For the

G O T H A G L I D E R

Designed By

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CHICAGO . . . . . ILLINOIS

GENERAL

The Gotha Glider was designed by H. P. Hutchison and Charles J. Glasser and associate engineers to meet the urgent demands of vast multitudes, whose increasing interest in aviation has been brought about by the tremendous developments in the aeronautical industry and the epoch making flights of Lindbergh, Chamberlin, Byrd and others, but who felt that they did not wish to involve a great amount of money in the building of a plane or in learning to fly. The Gotha Glider is the answer to the needs of those ambitious ones.

The Gotha Glider is a product of engineers whose experiences in designing and building of airplanes and gliders dates back as far as 1910. It is the product of men who have been connected with leading aeronautical institutions of learning and manufacture and are therefore capable by virtue of knowledge and experience to give to the aviation world -- THE GOTHA GLIDER, considered one of the finest all purpose gliders of today.

Due consideration was given in the design of the Gotha Glider to the elements of cost, simplicity of construction, strength, and ease with which one could learn to fly it. To demonstrate the care that was taken to effect a glider that was as near "fool-proof" as possible, each part was built and tested before incorporating it into the design, for example -- rib after rib was tested and while actually they must only support 18 lbs., these ribs withstood a strain of over 300 lbs. each before giving way. This is to impress that the Gotha Glider is "proven" and if the builder will construct it directly in accordance with the blue prints and this construction manual, the result will be successful.

There are over 10,000 gliders in Germany and probably as many more in France, England and America. The glider idea is far from new, for it was by means of gliders that the Farnams, Langley and the Wright Bros. learned the first principles of aircraft construction and flying. The Gotha Glider is particularly interesting to many because it enables them to learn the construction of aircraft by doing the actual building themselves, and material costs are so very small that almost anyone can afford this experience. The cost of the materials is estimated to be under $50.00, however there may be slight variations due to higher prices of lumber, etc., in some localities, but it can be well said that $50.00 will be ample. As there is no motor used for propulsion, gasoline, oil, parts, and other maintenance costs are of no consideration. Should one decide that they have not the time, the space, or for some other reason decide that he does not care to build the glider but would like the pleasure of flying it, the Gotha Glider can be purchased complete, ready to ship, for $100.00 f.o.b. factory -- plus crating charge.

Thousands use gliders because of the actual thrill of flying this type of machine and while many of the glider flights have only been of short duration, some have stayed aloft as long as 14 hours.

The first consideration in building the Gotha Glider is the selection of a place in which to build it. A garage, a basement, or any unobstructed room not smaller than 20 feet long and 10 feet wide will do but it must have large enough doors to get the parts out after they are built up. It is not essential to have enclosed space big enough to put the whole machine together, for this final assembly work can be done in the open. Some have built the entire glider out in the open, but it is advised that the construction work can be done inside wherever possible.

If the builder will get or make a work bench or table on which gluing, nailing, etc. can be done, the work will be found to be much easier. A few tools are essential and one should not begin the construction of the glider until they at least have these few tools.

1 vise	1 chisel
1 file	1 hand drill
1 hack saw	1 pair pliers
1 carpenter saw	1 sharp pocket knife
1 plane	1 carpenter square
1 carpenter hammer	1 ruler
1 tack hammer	

Any tools in addition to those mentioned may be found useful, but the above are absolutely essential.

MATERIAL

700' -- ¼" x ¼" finished in not less than 6' lengths.

150' -- 7/8" x 7/8" finished in not less than 15' lengths.

35' ---8½" x ¾" finished in 16'6" lengths.

35' -- 6" x ¾" finished in 16'6" lengths.

60' -- ¼" x ¾" finished in 8' lengths.

4 -- 3" x 1" finished in 8' lengths.

4 -- 1 x 7-3/32" pine 3 ply veneer

1 -- 1 x 7 3/16 birch 3 ply veneer

40 sq. yds. unbleached sheeting 72" wide, if possible, otherwise 36"

5 gals. acetate dope

1 gal. dope thinner (not paint thinner)

½ gal. spar varnish

1# 3/8" nails for ribs

1# 5/8 -- nails for fuselage

1' x 6' -- 20 ga. cold rolled steel.

RIB JIG

To construct the ribs so that they are all of a uniform curve, it is necessary that they be made in a form of jig. To make the rib jig use a flat board of not less than ½ inch thick, 5½ feet long and 11 inches wide, then lay the blue print (sheet 2) on the board and thumb tack the print down so as not to allow it to move, then with the sharp point of a heavy needle or sharpened nail punch holes around the outlines of the rib making pin point impressions on the board. These punched holes should be made not farther apart than every quarter inch, and if they are made every 1/8 inch along the front or "leading edge" a much more uniform rib will be the result. Care should be taken when punching the holes along the lower side of the rib not to follow the reference line but to follow the rib line. Do not allow the print to move while punching these holes. After the outline is punched all around, remove the blue print from the board and the outline of the rib will be on the board in small holes. By taking a pencil and drawing the lines in between these holes, the exact duplicate of the ribs shown on the blue print will be shown on the board. Cut a ½ inch piece off the mill-spar and nail it on the board in the places shown as spar spaces on the blue print.

It may in some cases develop that the rib outline does not fit exactly, however under no consideration change the dimensions of the spars. Nail a piece of quarter inch stock on each side of the curve of the rib as it has been marked out on the board. Now nail pieces on each side of the diagonal members of the rib. Do this in such a way that it will be a form for the rib itself.

If all this has been done correctly, then it should be possible to place quarter inch stock in the grooves made by the form and when nailed and glued with the gussets added it should be possible to lift the rib out of the jig and a perfect rib curve should be the result.

RIB CONSTRUCTION

It has been found that the best way to make a rib is to proceed thusly: First take a piece of quarter inch stock and push it from the back of jig through the groove forming the upper curve of the rib, then take a piece of quarter inch stock and place it in the groove forming the lower curve of the rib in the same manner, allowing about 2 inches of extra length on the front ends so that when the gusset is tacked on it will not cause this quarter inch stock to split. Then put in diagonal No. 1 (sheet 2) as shown on blue print. Glue the ends of this diagonal where it joins the top and bottom part of the rib curve and glue and nail on gusset "D" as shown on blue print. Glue ends and put in groove diagonal No. 2, then glue and nail gusset "C" and same with gusset "B". Next glue and put in

diagonal No. 3. Glue and nail on gusset "A" making sure that the end of this gusset comes even with diagonal No. 3 and that the curve marked out is followed exactly by this gusset "A". Continue to make the rest of the rib in the same manner and when the one side is finished, take the rib out of the form and turn it over, laying it on something flat where gussets can be put on the opposite side of all other gussets save the gusset "A", making sure that all gussets are glued and nailed. This should complete the process of making the rib and if they are made with care all ribs should be alike. Take a file and run lightly over outside edges of top and bottom of curve so that no roughness can cause the fabric to be cut, also smooth edges of gussets that are rough.

ASSEMBLY OF WING.

The first constructional detail of a wing assembly will be to taper the front and rear spar ends. This taper is only on the top side of the spars. Lay off the taper in this manner. Saw off squarely large end of these spars, that is to say, the ends of the spars that butt together. Then lay off a point called point "A" eight feet 4½ inches from the sawed off end and continue to a point 6 feet farther and 5 inches up from the bottom on the front spar and 4 inches up from the bottom on the rear spar which we will call Point "B". Continue 1 foot out to a point on the end and 1½ inches up from the bottom called "C" on both front and rear spars. Connect by pencil line points "A" and "B" and then "B" and "C". Plane to these lines. Mark off spar as shown in figure "A" (sheet 1) for rib distances. Slip on all ribs. Glue rib diagonals 3 and 4 and 9 and 10 (sheet 2) and tack to spar spacing tacks approximately every 2 inches. Next will be the placing of the false spars figures "C" and "D" (sheet 1). Do this by tacking a piece of quarter inch stock. Under the upper curve of the rib in the spar space, glue and tack down the end of this quarter inch stock as it joins point "A". Then attach to the upper curve of the rib. Continue this process with the remaining ribs making a slight bend with this quarter inch stock to a point "C" on the spar. Glue and nail to spar. Place spacer pieces of quarter inch stock between the actual spar and the false spar. Set in diagonals from the top and bottom of the front spar to the top and bottom of the rear spar using 7/8 inch stock. These compression members are to be placed 1½ feet from the tapered end and 7 feet 3 inches from the tapered end of the spars. Bolt fittings on spars as shown in Figures "C" and "D" (Sheet 1). Drill holes through fittings making sure not to drill these holes any larger than the size of the bolts used. It is better to force the bolts through the spars than to have the holes too large. Then bolt fittings to spars.

Next glue and nail quarter inch stock along leading edge of the wing in the gusset grooves in the ribs. Glue and nail 1½ inch round stock from rear spar to the leading edge along the tapered end of the wing, then join all quarter inch leading stock to this 1½ inch half round piece. Place flying wires between spars as shown on drawing Figure "A" (sheet 1). Add trailing edge of 1/4" x 3/8" stock and attach by short strip of veneer. Glue and tack.

FUSELAGE

The simplest way to construct the fuselage (body) is to lay out the dimensions on the floor as shown in FIGURE "B" (sheet 1) with reference line also marked. Place top and bottom longerons (lengthwise fuselage members) on the floor according to the blue prints, place nails in the floor so longerons will not shift about, but do not drive nails through the longerons into the floor. Then place diagonals as shown on print and attach by gluing and nailing the gussets. Turn over and put gusset on other side. This entire operation can be done again as both sides of fuselage are identical. Then join fuselage together top and bottom, as shown in FIGURE "A" (sheet 1). All top and bottom gussets will meet the longerons at the same point where the diagonal gussets meet the longerons. The scale for this FIGURE "A" drawing is one inch equal to one foot.

Set in 3/8 inch ply wood for floor board and control mount. Build seat of ply wood or, should the constructor not wish to go to this trouble, a board will serve that purpose. Place this seat with a slight tilt upward on a cross strut placed between the lower longerons. The forward end should rest on a lower strut supported by the gussets at the bottom of the vertical strut No. 2.

TAIL GROUP

In the construction of the tail group begin with the rudder and the vertical fin, again making layout on floor from FIGURE "B" (sheet 1) then proceed to make this in the same manner as the fuselage. The detailed blue print explanation regarding the horizontal fin and elevators FIGURES "A" and "B" (sheet 1) are of such a nature that further discussion will not make this any simpler.

SHEET METAL FITTINGS

All sheet metal fittings for the Gotha Glider are shown on sheets 3 and 4 and must be made strictly in accordance with them. Unless otherwise specified, fittings are to be made from 20 gauge cold rolled steel sheeting. First study the blue print and make sure you know just what each fitting's particular function is. Then lay out the fittings on the sheeting so as to get some economical arrangement and thereby secure less waste. Now cut the fittings out leaving about an eighth inch border to be filed off down to the line. In cutting out the inside of a fitting either a chisel may be used, followed by a file, or a drill and a hacksaw followed by a file. In all cases file to the line exactly. Bend as shown in prints by hammering on a table edge -- a pipe or whatever will give you the desired bend. All bolts are to be 3/16 inch diameter , unless otherwise shown and holes are to be drilled snug. In any case,where the fitting does not seem clear, try to visualize its purpose.and location with reference to other parts, if necessary construct members around it and the fitting later.

STRUTS

Struts are to be made from 1" x 3" stock, cut to length shown on sheet 1. They are then to be streamlined with their widest point 1" back from the leading edge, and one inch thick. At each end, they are to be finished round, with the center of the circle one

inch from the leading edge. This round portion should be 8" in length at each end. These ends fit into the 7/8" tubing and are secured in them by a 3/16" bolt which is placed near the open end of the fitting to give plenty of wood between it and the end of the strut.

CONTROLS

To make the controls and control wires the best method is to set the glider together first. It is then possible to cut the wires to the correct size. Bolt wing spars together and bolt struts from bottom of fuselage to wings. Place the horizontal fins and stabilizers on fuselage. Put on vertical fin and rudder. The glider is now assembled. Cut wires to run from each side of the rudder bar to the rudder horns so that when the rudder bar is pushed to the right the rudder itself will move to the right and vice versa. These rudder wires should run under the seat.

Mounted on the floor board between the seat and the rudder bar should be the stick control, details of which are shown in Figure "G" (sheet 3) and with it any simple pulley arrangement that will allow the elevators to move upward when the stick is pulled back and will allow the elevators to move downward when the stick is pushed forward. Construct a farrel arrangement on the floor board at the lower longerons so that the wires can operate when the stick is moved to the left or right. A loose pulley arrangement can be made on the lower end of the front spar five feet from the wing tip. Thus the wire will run from the stick around the farrel through the pulley on the lower side of the front spar to the lower aileron horn. There should be a loose pulley on the top side of the front spar directly over the pulley on the lower side of the front spar. A wire will run from the top elevator horn of one wing through the pulleys and thence to the top aileron horn of the other wing. The operations being such that when the stick is pushed to the right the right aileron will move upward and the left aileron will move downward and when the stick is pushed to the left the reverse action will take place.

SKIIS

A pair of five foot ash skiis, or if these are not obtainable, a standard 7½ or 8 foot ski may be purchased and cut off. They are secured to the fuselage by fittings shown on sheet four and placed about three inches below the lower longeron. The upper bolts should be placed through a block filler placed between the gussets of the fuselage at this point and taken up tight. Sixteen gauge cold rolled steel should be used in these fittings. Rubber washers or compression pads secured to the ski and longeron will make excellent shock absorbers if they are desired.

COVERING AND DOPING

For covering the wings and tail group use unbleached sheeting 72" wide, if possible, and if not, 36" wide will do. Cut this material

in 10 feet 7 inch lengths and sew tightly together so that the result will be one piece 16 feet long by 10 feet 7 inches wide. Lay this material over the wing and pin the two ends of the cloth along the trailing edge. At the section of the wing where cutaway is made for aileron, pin extra material next to the rear spar. Draw this material fairly tight and closely sew all open ends. Cover ailerons and tail groups in the same manner. Procure a needle about 10 inches long and fairly thin and sew covering along the rib through the bottom covering and then bring the needle back up on the other side of the rib to the top and tie the string. Make these stitches every eight inches along the rib. Only every other rib need be sewed this way. The object of this operation is to keep the covering close to the rib. Do the same thing on the aileron and tail groups.

With the covering all finished, the next step is the doping of the fabric. For this 5 gallons of acetate dope and 1 gallon of dope thinner (not paint thinner) will be necessary. This doping must be done by brush in a room temperature not below 60 degrees Fahrenheit. When applying the dope, if it turns a murky or cloudy white color, it is a sign that the room temperature is too cold. The dope should have a clear crystal yellow color when dried. Normally this drying takes about 20 minutes. Apply the first coat of dope fairly thick as the material will absorb most of this first coat. Cut strips of fabric 2 inches wide and as long as possible. When putting on the second coat of dope, cover all seams with these strips and run them over the full length of the ribs that are stitched. These fabric strips will stick to the covering by being dabbed heavily with dope. The second, third and fourth coats of dope should be thinned with thinner in about the ratio of 4 times the dope to one amount of thinner. Pour out only about 1 quart of dope at a time, as it sets very quickly. Should a fine smooth finish be desired, it can be had by a final coat of spar varnish.

HOW TO FLY A GLIDER

It remains a mystery to many as to just how flights can be made without the use of a motor and though there have been long and varied explanations the following is a scientific analysis of gliding and soaring flight.

Figure 1, page 10, shows a barrel in position A, resting on point P, or point of pressure. CG indicate the center of gravity. When the barrel is in position A, the center of gravity is forward of the center of pressure point P. Then the barrel must by force of gravity, etc., move to the right, or down the runway, and would run to position "C" but the frictional forces and the gravitation all pull only allow it to go as far as position "B", but if at positin "B" the runway was suddenly shifted to the left or downward, the barrel would be forced to continue upward. This action caused by the moving of the runway would of course force the center of gravity in advance of the center of pressure and thus the barrel would continue to position "D" which shows the center of gravity in a line with the center of pressure. This static position is the position in which soaring flight is done.

The above is a direct comparison of glider flying as shown in Figure 2, page 10; the plane in position "A" is the same as the barrel in its position "A". The plane in position "D" must have some reverse force which will act in the same way as the runway being shifted back, but in the case of the glider the wind coming against it causes a similar action to the runway being shifted back as in figure 1. Position "B" 1, Figure 2, shows the plane coming out of diving position "A". A1, B1 for should there be no oncoming wind the glider would be unable to continue upward and would therefore have to land.

Just a short description of the controls and their action may serve to bring about a better understanding as to flying the glider. The ruddor bar is operated by the pilot's feet and when the pilot wishes to turn to the right he pushes his right foot forward; and when he wishes to turn to the left, he pushes his left foot forward. The control stick operates forward and backward and sideways to the right and left. When the pilot wishes to move the plane downward he pushes the stick forward; and if he wants the plane to head upward he pushosthe stick forward and if he wants the plane to head upward he pulls the stick back. When he wishes to lower the left wing he does this by moving the stock toward the left, etc. Operate the controls according to the senso of feeling of the pilot, for instance, if the glidor is diving downward the natural senso of feel of the pilot will be to pull abackward on the stick. That is the exact action to perform.

If the right wing would be flying low, the natural thing would be to lean to the opposite or left side and by moving the stick to the left the plane will return to its correct flying position. Extreme care must be taken never to nose the glider up at too great an angle from a horizontal position, for if there does not happen to be enough flying speed then the machine will stall and dive and mishap may result.

It is not advised that the pilot attempt anything but long, straight glides downward. The Gotha Glider is more of a gliding plane than a soaring plane, therefore, use it for gliding only until long experience has been gained.

Figure 4, page 10, shows the method of launching a glider. A rope or wire of from 50 to 75 feet in length is used. This rope is usually attached to the glider by means of snubbing around a small stick and arranged in such a way that the pilot can release this rope or wire. The best territory over which a glider can fly is hilly country but not where there are cliffs or drop-offs. If winds prevail, so much the better. Always take off and land against the wind and under no consideration take off or land in the same direction from which the wind is coming.

Takethe glider up to the top of some hill or dune as shown in Figure 3, page 10, with a number of people pulling on the rope as shown in Figure 4, page 10, and with at least one person at each wing tip. As soon as a gust of wind starts blowing, or right prior, all start running and pulling on the rope with those at the

wing tips pulling forward and raising the wing at the same time. After a sufficient speed has been gained, the pilot should pull the control stick back just slightly. This will help to raise the glider farther from the ground. The pilot should then release the drag rope and complete the rest of the glide. If the pilot feels a strong wind blowing against him, he can nose the glider up very slightly and thereby increase the distance of his flight a little and then start to glide downward again on a gentle angle.

Try always to bring the glider to the ground at a very slight angle and level the glider to a horizontal position so that it is parallel to the ground when about 6 inches above the ground.