

The diagram shows the latest developement in a line of soft wing machines which have been built and flown over the last few years. THERMALIST FOUR B 2 is, like its predecessors based on a total projected plan surface area of 32 square feet. This area has been maintained with each THERMALIST produced as one is then in a far better position to judge whether or not the modifications made to each model are improving the performance of the marque.

Should any fellow K.O.N. reader wish to build a THERMALIST from the plan then the following points covering its construction should be of help, bearing in mind that it took a fully skilled seamstress over twenty hours of high speed machining to sew it up, together with an additional eight hours of work for rigging the shrouds and for finishing it off satisfactorily.

1) Begin construction by carefully marking out onto paper using the dimensions shown in the plan (which are in feet) the vertical rise - (rib) making certain that its maximum height is $15\frac{1}{2}\%$ of the total chord length (six feet) and that this dimension is positioned on the vertical axis 32% along from the leading edge. The two dimensions are critical to acheiving good low wind speed performance and have been arrived at via THERMALIST One, Two and Three and many hours of research in aeronautical journals, and field trials. To emphasise the point, number Three had a chord thickness of 17% and flew like a lead lined barn door.

2) Once the rib outline has been plotted and drawn onto good quality paper (try paper from Telex machines) add a $\frac{3}{8}$ " margin all round the original rib outline and cut out the paper pattern to this second line.

3) Next draw up paper patterns for the vertical fins of which there are four sizes, each size consisting of five fins. The dotted lines in the sketch show the position of each ventral along the lower (underside) of the wing chord. It should be noted that as there are twenty fins in all, they are only sewn directly beneath ribs 3, 5, 7, 9, 11. Again allow a $\frac{3}{8}$ " margin all round the four separate paper patterns and cut out to this line.

4) Mark out the side skirts, shown by the solid lines enclosing the dotted ventral fins beneath the vertical rib onto paper, again adding a $\frac{3}{8}$ " margin all round. Cut out the paper patterns.

5) There should now be six different paper patterns. One for the vertical ribs. One each for the four sizes of vertical fin and finally one for the side skirt.

6) Arrange the patterns onto $1\frac{1}{2}$ oz per square yard ripstop nylon and very carefully cut out 13 ribs, 5 each of the four sizes of vertical fin (20 in total) and 2 side skirts.

7) Set up your sewing machine with a new size 90 needle (which should be changed at the first sign of bluntness) threading it with cotton thread. Do not use nylon thread. Sew all the $\frac{3}{8}$ " wide margins into a rolled hem $\frac{1}{4}$ " wide with the remaining $\frac{1}{8}$ " being folded under this $\frac{1}{4}$ " wide hem so that no cut edges can be seen. The outer edge of the hem finish on the dimension lines shown in the plan. These hems must be made at this stage on all the raw cut edges except those on the upper curved section (camber) of the vertical ribs.

8) Cut two six foot long lengths of 36" wide material which will form the lower surface of the wing and sew them together using a rolled hem so that a sheet of material 6 ft long by 6 ft wide approximately is formed. It is a good idea to trim the two edges of the material forming the central rolled hem straight prior to sewing. This is due to some ripstop displaying a definite curve over such a length.

9) A very good straight edge can be obtained by using a sixteenth inch thick aluminum strip 3" wide by 6 feet long cut on a guillotine by a local sheet metal manufacturing company.

10) Using tailors chalk mark an edge at right angles to the central seam at one edge of the panel, trim up square and sew a rolled hem which will form the leading lower edge of each vertical cell. Square up the two sides running parallel to the central rolled hem cutting to the plan width plus $\frac{1}{8}$ " either side. Hem up these two edges as before. NOTE. When marking out the width dimension take one side of the $\frac{1}{4}$ " wide central hem as the centre line of the lower panel. This will enable the central rib to be sewn dead in the centre of the panel with the ribs own $\frac{1}{4}$ " wide hem sitting exactly on top of the lower panels hem and not overlapping it by $\frac{1}{8}$ ".

11) Do nothing at this stage to the lower panels trailing edge as this will be formed into a rolled hem along with the top surface of the wing on completion of all the sewing operations, bar one.

12) Lay the lower panel onto a flat surface and smooth out all the wrinkles. With the straight edge mark out in chalk on the panels surface eleven parallel lines running from the leading to trailing edge, these marking the positions of the vertical ribs 2 to 12. Starting from one side of the panel sew into position each vertical rib using two lines of stitches down the $\frac{1}{4}$ " wide hem. Each line of stitches should be three sixteenths of an inch apart down the centre line of the hem. Each rib should have its lower hem pointing towards the rolled hem on the centre of the panel. When the central rib is in position directly over the central hem change the direction in which the hems of the remaining ribs are sewn so that these, too, will point towards the centre. Continue sewing in ribs finishing with 13.

13) Turn the lower panel over and place on a flat surface taking care that all the ribs point away from the panels centre whilst underneath and smooth flat. With the straight edge square a chalk line onto the panel from one side of the trailing edge to the other. This line must be at right angles to the panels sides and will need to be adjusted for position so that all the vertical ribs trailing points, where they finish on the rear of the lower panel, are covered by the chalk line. Whilst some rib points will extend beyond this line due to slight sewing variances as long as all the points meet or extend beyond the chalk line toward the trailing edge the line is in the correct position.

14) Cut into 2 $\frac{1}{2}$ " lengths thirty three pieces of $\frac{1}{8}$ " wide cotton tape and fold each one in half. Onto each tape fit one aluminum $\frac{1}{8}$ " wide throat "D" ring. Take twenty of these assemblies and pin one onto each of the points of the ventral fins making sure that the fin lies between the folded tape. Fold the ends of the tape over so that the cut edges of each end of the tape are hidden, finally checking to see that the tape points directly in line with its respective bridle line as shown on the sketch. Sew each tape with the "D" ring into position on the twenty fins.

15) Starting from the trailing edge begin to sew into position the rear ventral fins directly under vertical rib 3, with the hem of this fin pointing toward the central line of the panel. Before reaching the front of the fin with the stitches lay the rear point of the next smaller fin onto the front of the rear fin in the position shown by the dotted lines. Repeat this procedure with the next smallest fin and then finish off this line of ventral fins by positioning the front of the last fin exactly on the lower panels leading edge. Repeat this operation for the fins under ribs 5 and 7 and then changing hem direction 9 and 11. By working from the trailing edge to the leading edge when sewing the fins into position all the hems will point toward the centre line of the panel and secondly the overlap between each

fin will be held tight by the bridle lines. Turn the whole panel around 180 degrees returning down each line of stitches securing the fins; three sixteenths of an inch from the first line finishing off at the trailing edge.

16) Pin into position on each of the two side skirts four tape and "D" ring assemblies in the positions shown by the bridle lines and sew on as before with the ventral fins. Stitch an additional tape with "D" ring onto the pointed end at the rear of each side skirt.

17) Sew the first side skirt directly underneath vertical rib 1, remembering once again to point the hem toward the panel centre. Sew the second skirt underneath rib 13 again remembering the hem direction.

18) Cut two 36" wide of ripstop material into two seven foot lengths. Prepare a second panel and sew up in the same way as the lower panel having hemmed sides and leading edge leaving trailing edge raw. Remember to make the central rolled hem offset and make sure that this is biased to the same side as the lower panel when it is finally sewn onto the vertical ribs.

19) Take this upper panel and lay it out smooth onto a flat surface and chalk onto its top surface eleven parallel lines as before with the lower panel. Place panel to one side.

20) Lay the lower panel onto a flat surface with the vertical ribs upper most and smooth flat. Carefully take the top panel and pin its leading edge to the upper leading point of rib 1 only, taking into account that $\frac{3}{8}$ " of the ribs upper curved raw edge will eventually become a hem. Continue pinning the upper surface panel onto rib 1 finishing at its trailing edge. Measure 73% along a line running parallel to the lower surface beginning from the top panels leading edge and chalk mark this position on the edge of the top panels surface. This point is shown in the sketch by a star on the vertical ribs upper curved surface. Remove all the pins.

21) Take the top panel and place it onto a flat surface. Measure $\frac{1}{2}$ " beyond the chalk mark toward the trailing edge and then draw a chalk line at right angles to the central hem and cut along this line. Set the two sections aside.

22) Cut 16 plastic strips, one sixtyfourth thick $\frac{1}{4}$ " wide with a length equal to the distance between each vertical rib less $\frac{1}{4}$ ". Round ends off.

23) Take the front half of the upper panel and sew its trailing edge up into a rolled hem so that each plastic strip will fit snugly into the centre of the hem. Repeat this operation with the leading edge of the rear half of the upper panels.

24) Make 24 one thirtysecond inch thick, $\frac{1}{4}$ " diameter plastic discs and drill four holes into each one so that they look like flat buttons. NOTE. The one thirtysecond inch dimension is important. (On Four B 2 transistor spacers were used after trimming off the excess with a sharp knife).

25) Insert four plastic strips into each side of the hem made in the top surfaces trailing edge and also into each side of the top surfaces leading edge of the rear panel. The tips of the first plastic strips inserted into either side of the hems should be positioned so that they are $\frac{3}{8}$ " short of the chalk line where the upper curved edge of vertical ribs 5 and 9 respectively will be stitched to the top panel. Position the second set of strips so they are $\frac{3}{8}$ " short of ribs 4 and 10. Position the third set $\frac{3}{8}$ " short of ribs 3 and 11. Finish off with the last set of strips inserted $\frac{3}{8}$ " short of ribs 2 and 12.

26) Without disturbing the positions of the strips in the hems gently place the rear section of the upper panel onto a flat surface with the top uppermost (chalk lines showing). Carefully lift the front section of the upper surface and position its trailing edge so that its hem, with the strips, is directly over rear panels hem with the strips in it. There should now be $\frac{1}{4}$ " overlap by the front sections rear edge over the rear sections front edge. Use the chalk lines marking where the vertical ribs are to be stitched to the top panels to ensure parallel. Pin together the upper front and upper rear panels at cells 5,6,7 and 8.

27) Place one of the $\frac{1}{4}$ " diameter discs between the upper and lower strips of cell 4 halfway from either end of the strips. Using a Tool-makers pin vice with a 0.020" diameter drill pierce a hole through the upper hems fabric, strip and fabric underneath to align with one of the holes in the disc. Without moving the hem on the panel underneath check for alignment of the lower strip and drill through this hems material, strip and out the other side. Remove the drill and place a needle into the holes made in both strips. Repeat the operation to make further holes which will pass through the remaining holes in the disc.

28) Sew the top surface strips to the lower strips with the disc inbetween. Repeat the same operation for the centre discs of cells 3,2 and 1, checking the alignment of the chalk lines with each successive cell stitched together.

29) Sew into position a disc $\frac{1}{8}$ " from either end of each plastic strip for cells 4,3,2 and 1. One side of the upper surface is now complete.

30) Repeat the whole operation for the other side of the top surface assembly starting with the centre disc in cell 9 then 10,11,12.

31) Sew a double line of stitches between ribs 5 and 9 and the top surface is now finished.

32) The top surface assembly can now be stitched to the vertical ribs which are already sewn to the lower panel. Starting with the top surfaces leading edge start sewing it to the vertical rib 1, remembering to point the ribs hem towards the centre line. On reaching the trailing edge with the stitches return back up the hem to achieve a double line of stitches which should be three sixteenths inch apart.

33) Repeat this operation for vertical ribs 2,3,4,5,6 and 7 remembering hem direction and then changing hem direction stitch ribs 8,9,10,11 12 and 13.

34) As the cells hem of rib 13 cannot be sewn internally, begin by stitching the rib to the top surface with $\frac{1}{8}$ " of the ribs curved edge protruding outwards. From the trailing edge begin to return stitch up the seam by folding the $\frac{1}{8}$ " margin into a $\frac{1}{4}$ " wide rolled hem flat onto the top surface panel. Because this second line of stitches are being sewn internally from the trailing edge of the cells rear aperture the sewing machine will only allow the stitching to go so far before the excess of material around the machine sewing foot will bring the line of stitches to a halt. Cut the threads and as before restart sewing from the leading edge continuing until the line of stitches started from the cells rear are reached and passed by with approximately 1" of stitches.

35) Pin the top surface to the lower panel on the chalk line left on this panels trailing edge. Leaving a $\frac{1}{4}$ " wide strip, cut off the excess material from the upper and lower panels raw trailing edges. Remove the pins.

36) Fold and fold again the two raw trailing edges so that a rolled hem is formed on the underside of the lower panel. The front edge of this fold should extend $\frac{1}{8}$ " beyond the trailing edge chalk line previously

made, towards the front of the wing. Sew a line of stitches on the hem directly over where the chalk line is hidden from view. Repeat with a second line, $\frac{1}{4}$ " behind the first line of stitches which now finishes off the trailing edge with a firm rolled hem of material.

37) Sew into position one tape assembly with "D" ring directly onto the trailing edge at the central rolled hem position of the panels.

38) Again onto the trailing edge sew a tape with "D" ring 15" from the centrally positioned ring. Repeat for the tape assembly on the opposite side.

39) The sewing operations for the construction of the wing are now completed and all that remains is for the shrouds (bridle lines), drogue lines and side skirt trailing edge lines to be fitted.

40) Suspend a plumb bob from a ceiling lamp rose (or similar) so that its pointed tip is $\frac{1}{4}$ " off the floor.

41) Place the wing onto its back and gently smooth it out ensuring that the upper panels vertical ribs seams are directly over those of the corresponding lower panel seams. Move the whole wing gently towards the plumb bob and position it so that the point where rib 7 meets the lower panels leading edge is directly underneath the bobs point.

42) Place two lengths of heavy timber each six feet long either side and almost touching the ventral fins of rib 7.

43) Take a length of light nylon line and secure one end onto the same point from where the plumb bob is suspended. At a vertical distance from the floor tie an $1\frac{1}{2}$ " diameter split steel key ring onto this second line with its centre to floor distance being at 7'3".

44) Cut four 8' lengths of 40 pound breaking strain line and by taking them all together tie a single half hitch onto the suspended $1\frac{1}{2}$ " diameter steel ring, ensuring that there is approximately 4" of excess line remaining beyond the hitch. Pull tight. Repeat the half hitch with the excess line again and again pulling tight up against the previous hitch with each one made until there is over $1\frac{1}{2}$ " in length of half hitches running down the long length of the four line group. Seal all the hitches with nail varnish and trim off the remaining excess short lengths of line.

45) Take the first long line on the steel ring and pass it through the "D" ring on the front central vertical fin. Pull gently on the line until this fin is standing upright with no sag in the fins material

46) Tie the line onto the "D" ring with a "Perfect Knot" ensuring that the line and ventral tension is maintained whilst it is tied. (See Knots & Splices by Cyrus Day Granada Publishing for a description of this knot). Trim off the excess line. Take the second line on the ring and in the same manner tie it to the second ventral fin from the leading edge held between the two timbers. Repeat the same operation on ventrals three and four. Do not forget to seal all knots with nail varnish.

47) Cut another four lengths of line slightly longer than the original four and tie them as before onto the steel ring. Carefully insert a second set of timbers either side of the ventrals above vertical rib 5 ensuring that the panels are still flat and that that the plumb bob is in its original position over the leading edge of vertical rib 7. Take the nearest line on this second group which is next to the first group of lines on the steel ring and with a "Perfect Knot", as before tension up, and tie up the front ventral fin of rib 5. Repeat with line 2 of this second group to ventral 2 and so on to line four and ventral 4.

48) Mount onto the steel ring another group of four lines (similar in

length to the second group), adjacent to the group of lines supporting the ventrals of rib 7.

49) Remove the two timbers from ventrals 5 and gently place either side of the ventrals above rib 9 ensuring that the panels are still flat and have no wrinkles. Tie up this group of four ventrals as for those of ventrals on rib 5 ensuring that each line is of the same length as those for the four lines supporting rib 5 ventrals by using a steel tape measure to compare line lengths.

50) Repeat all the relevant steps above for ventrals 3 and then 11 finally finishing off the rigging of the shrouds by securing the side skirts to their respective lines. The timbers on this occasion should be positioned next to the skirt face which is facing the central rolled hem of the panels. The rigging of the shrouds is now complete but DO NOT remove the $1\frac{1}{2}$ " diameter steel ring from its suspension line.

51) Cut two lengths of shroud line each $3\frac{1}{2}$ ' long and tie them to the "D" ring mounted at the center of the trailing edge. Maintaining the same degree of skirt angle which is supported by the shroud line running up to the steel ring attach one of the lines onto the "D" ring mounted on the very tip of the skirts trailing end. Repeat for the other side skirt. The ring can now be released from the suspension line.

52) Cut an 11' length of lightweight three strand model aircraft control line wire and slide onto one end a $\frac{1}{4}$ " length of one sixtyfourth inch bore brass tubing. Thread the end of the wire, but not the tube, through one of the two remaining "D" ring assemblies on the trailing edge of the wing. Sliding the brass tube up towards the "D" ring pass the free end of the wire back down the tube so that the wire is secured to the "D" ring by a loop. Adjust the loop to a neat size and then crimp the brass tube in several places with wire cutters to secure the loop fast.

53) Take a similar piece of tube and slide it onto the free end of the wire for a distance of approximately $5\frac{1}{2}$ '. Hold the tube in this position and with the free end of the wire pass it back up the tube until only a small loop is showing.

54) Mount the free end of the wire onto the opposite "D" ring using a tube as before and crimp the loop secure.

55) Adjust the position of the center brass tube containing the two wires until they are of equal length about the tube. Leave a small loop showing and then crimp the tube to secure. Add a $\frac{1}{4}$ " diameter split ring to this loop together with a small lightweight swivel.

56) Cut 18' of wire and mount a $\frac{1}{4}$ " ring onto each end using a tube as before. Carefully roll up onto a wooden storage reel securing the free end. Place to one side.

57) From ripstop nylon build a *drogue* to the size shown by making a paper pattern first. As a *drogue* when opened up will form a segment of an annulus mark a 3' and $1\frac{1}{2}$ ' radii onto the pattern. The arc of each radii being πD of the two diameters shown on the plan. Sew up the *drogue* into a cone with a rolled hem at either end. Equi-spaced around the largest diameter opening sew on three "D" ring assemblies with tapes. Tie three $1\frac{1}{2}$ ' long lengths of shroud line onto a $\frac{1}{4}$ " diameter split ring and secure the knot with varnish. Tie and varnish each line onto its respective "D" ring on the *drogue*.

58) The THERMALIST is complete and ready for flight.

59) As the wing has been specifically designed for very low wind speeds test flying should only be carried out in a 1 to 4 mph wind speed.

60) The flying line should be 150 pound breaking strain braided

nylon line with a large swivel mounted on the end. DO NOT tie the line to the swivel as almost any knot will reduce the line breaking strain by at least half. Use a small thimble obtained from a boat chandler for all flying line terminations. Pass the line round the groove on the pear shaped thimble lashing the short end back onto the main body of the line with Racking Seizing for at least four inches. Trim of the excess line and varnish the whole Racking. To secure the finished line to the swivel use a miniature shackle again obtainable from the chandler. A similar shackle should be used to secure the swivel to the 1½" diameter ring on which the shrouds are mounted.

61) Under ideal conditions it will be possible to fly the wing without a drogue but as the wind speed increases one should be fitted using the 18' long steel drogue wire. Do not use the drogue without this line as it will impair the optimum performance of the wing.

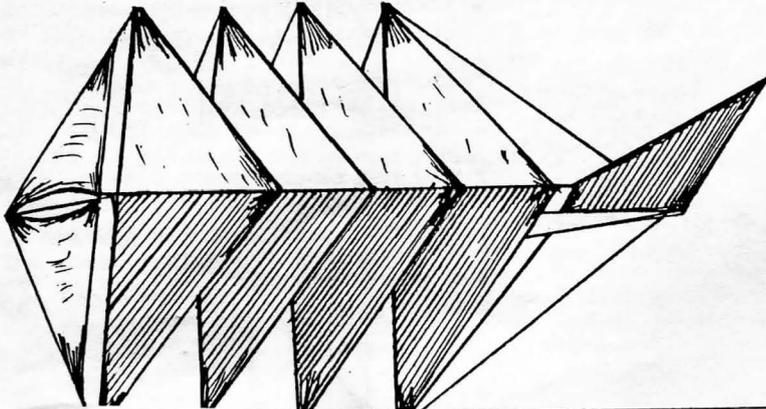
62) The very best flying can be obtained on warm sunny days when the wind speed is almost zero at ground level. Pay out 150' of line and with the assistance of someone holding the wing open by the leading top edge run into the wind's direction. The wing will rapidly climb to over 100' when it will be lifted by the higher wind speeds found at this height. By moving around the flying field one should soon find a thermal which will enable the THERMALIST to come into its own and where a flying line angle of nearly 90 degrees to the horizontal will be achieved.

63) As you are now the possessor of one of the finest soft wing machines currently around treat it with great care especially when folding it up as the plastic strips which form the upper panels slots can easily be damaged but are difficult to replace.

MARCONI RIGGED?

Dick Faulkner writes "In the August issue of K.O.N. there is a letter from Mr P. Chapman re a strange Triplane kite, in which he is interested and thinking of making. Mr. Chapman says it looks good - Yes it does! All the same it is a fraud, I fear. The Marconi Rig Kite did not appear (in flying form) until about 1944. From 1897 - 1910 there was a glut of people designing very exotic looking kites - eye catchers, but dud flyers. You can be quite sure that if any of these strange kites had been any good their design would have been in use today. I am not in anyway throwing cold water on a study of old kite designs. There are about 300 books and magazines in which reference to strange kites can be found (I myself discovered The German Roller from such a study). It is the best kite I have ever flown! and I have flown so many. Hoping the above will be of interest to Mr Chapman."

Steve Gooding writes to say that in "Kitecraft" by Lee and Jay Newman there is a very similar kite built and flown by Art Kurle in America.



Sketch of the Art Kurle four masted schooner as mentioned by Steve Gooding.