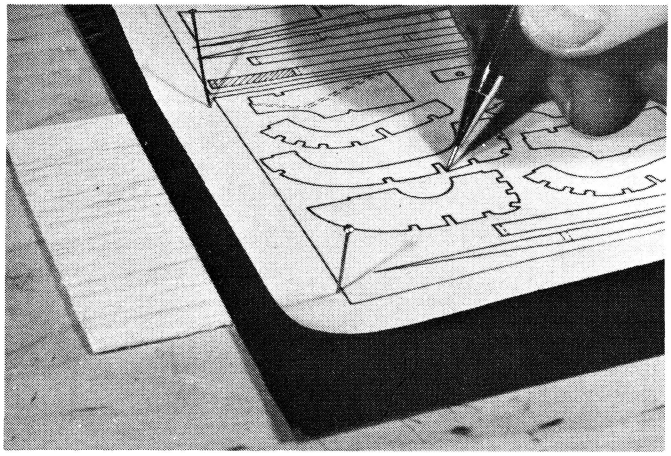
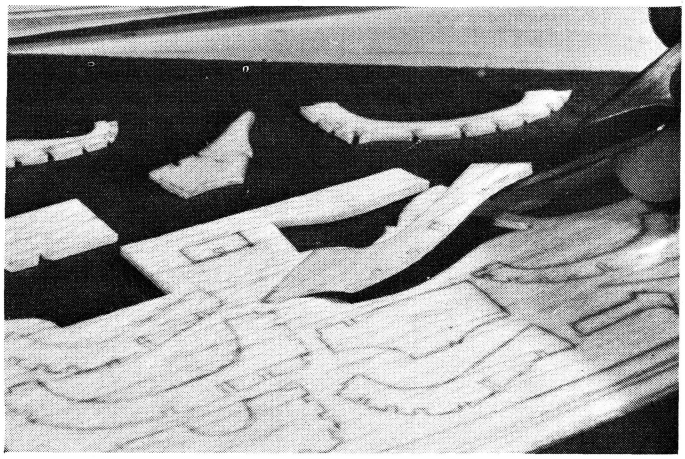


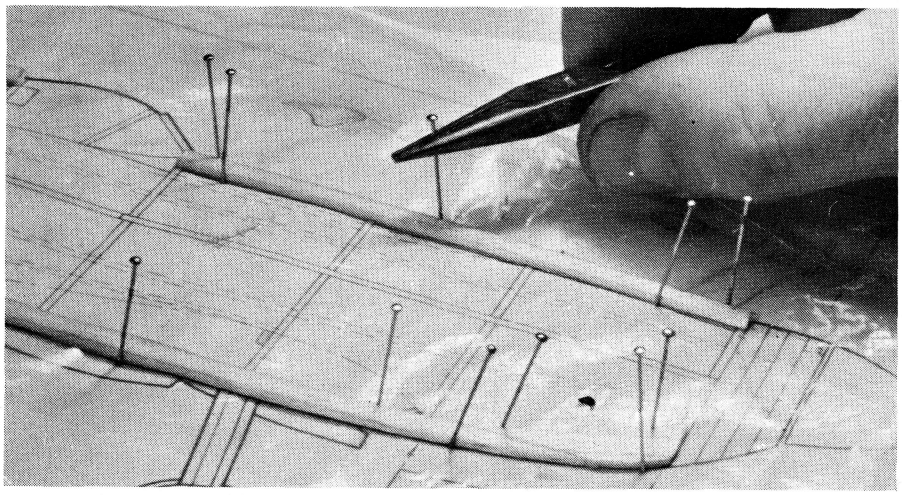
1. Place a piece of carbon paper over a sheet of balsa wood of the thickness specified on the parts layout being used. Position the layout carefully over the sheet and pin it in place. Trace the outlines accurately, using a medium hard pencil.



2. Using a sharp-pointed modelling knife, cut around each component piece and remove the small stringer slots afterwards. For uniformity of this last operation, it may be found easier to use a Swiss file of the appropriate width.

Building and Finishing

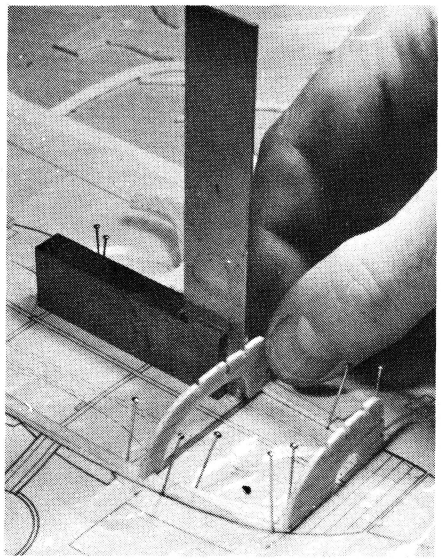
By J. D. McHARD



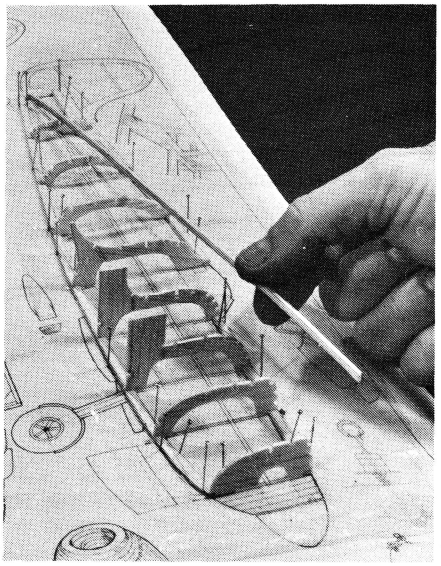
3. Glue the keel pieces together where necessary and position them over the fuselage side view, after first of all covering the plan with a sheet of thin transparent polyethelene to prevent the glue from sticking to it. Pins holding the keel pieces in place should be positioned on either side of the wood and never stuck through it. Ensure that the building surface over which the fuselage is assembled, is perfectly flat and soft enough to enable the pins to be inserted easily. Half-inch insulation board or sheet balsa is suitable for these small models.

Having completed the airframe a decision has now to be made on whether we are going for maximum flying performance or maximum realism. Much as one would like to have both, it is unfortunately not possible. The achievement of a high degree of realism inevitably involves the addition of weight, and no matter how little additional weight is added, the performance will undoubtedly be decreased.

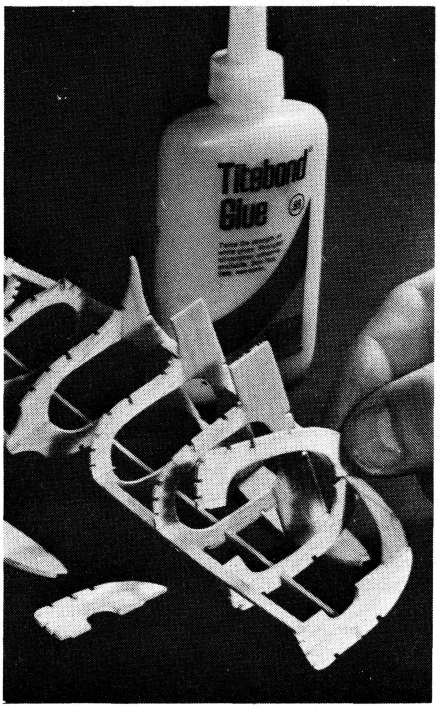
If you really want high duration from a rubber powered model then you must forgo color dope. However, it is possible to achieve an acceptable performance and high degree of realism provided one is aware of the fact that weight is so critical and that a certain amount of time must be spent in developing the art and skill of applying a lightweight color finish by use of an air brush such as the Badger 100 or the De-Vilbiss as used by artists and photographic re-



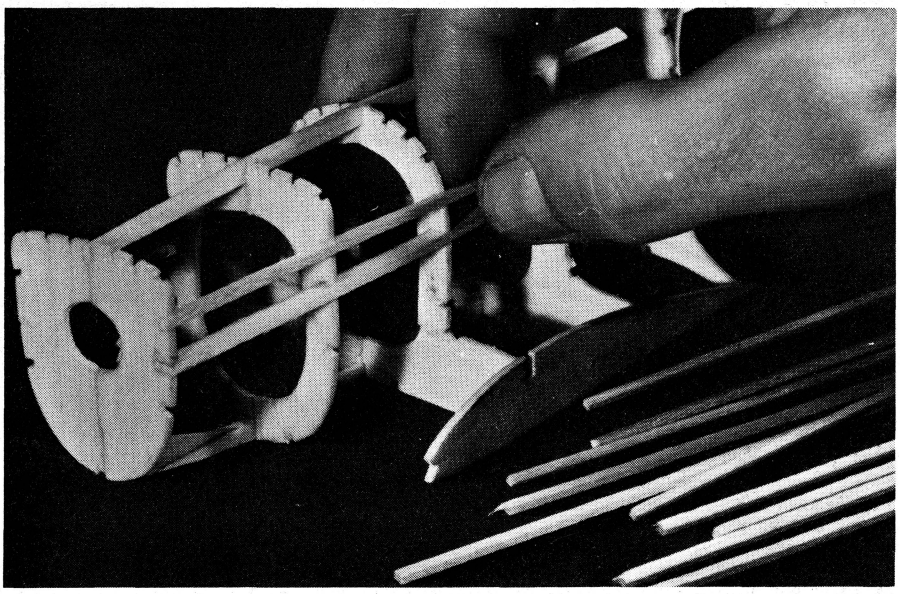
4. (Left) Glue the half-formers in position over the plan, using a set-square to ensure that they are perfectly vertical.



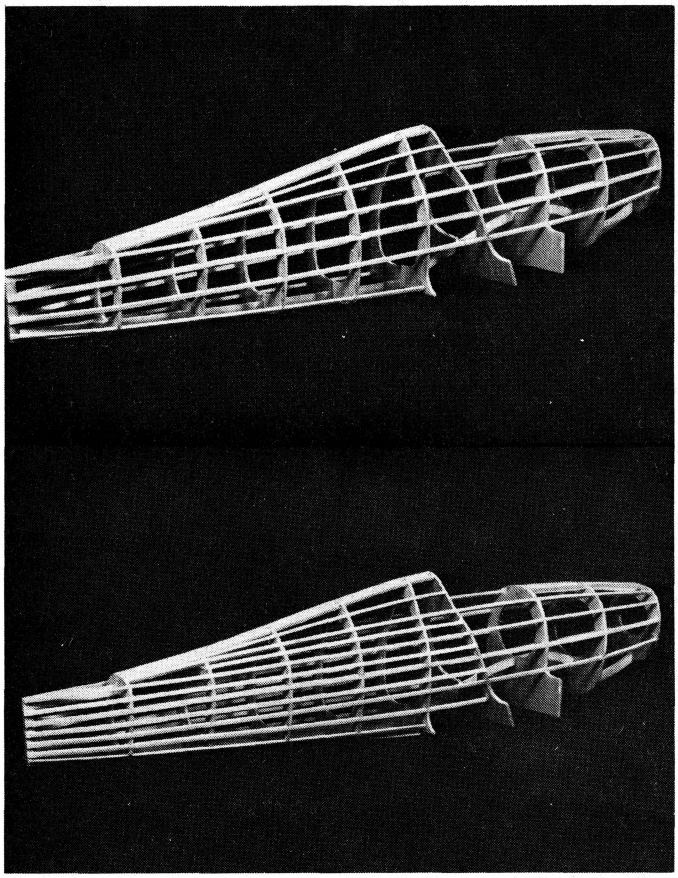
5. (Right) When all half-formers are in position and the glue has set, stick the side keel in place, checking that the half-formers remain perfectly upright and adjusting the side keel slots if necessary, to ensure a perfectly straight line is maintained from front former to tail post.



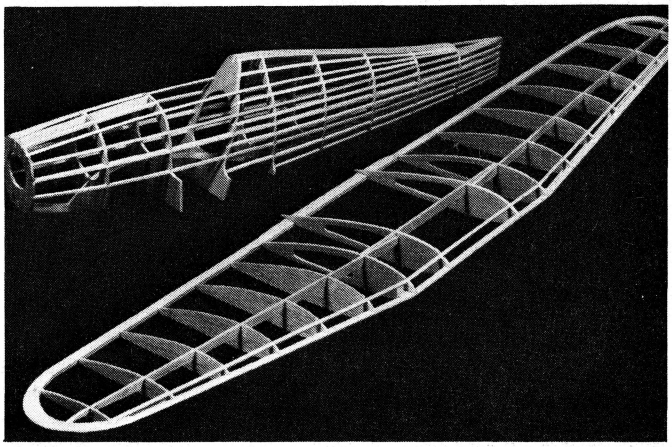
6. When dry, remove the construction from the plan and glue in place the opposite halves of the formers, carefully lining them up and ensuring absolute "squareness."
Titebond Glue is recommended for all constructional work with balsa wood. It can be diluted slightly with water if desired.



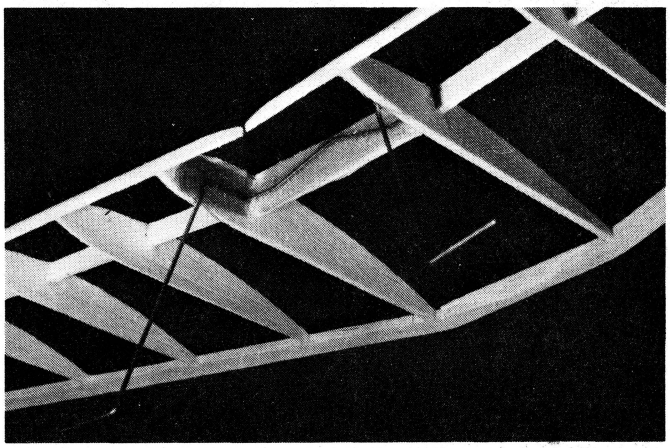
7. After positioning the second side keel, the 1/16th sq. stringers are placed in their slots, ensuring that they form perfectly smooth runs from front to back. Fix the stringers alternately . . . one to the left side and then one to the right side of the fuselage, to reduce the possibility of distorting the framework. Use a pin or a sharp-pointed piece of 1/16th sq. to apply the glue in the stringer slots.



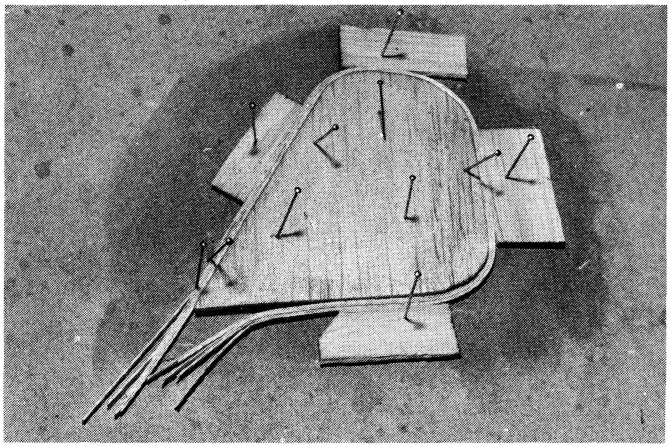
8. Here is the completed fuselage basic structure. Check it carefully to ensure that no warps have accidentally been built into the structure, and carefully sandpaper the whole assembly to remove any rough spots which would prevent a smooth covering job to be carried out later.

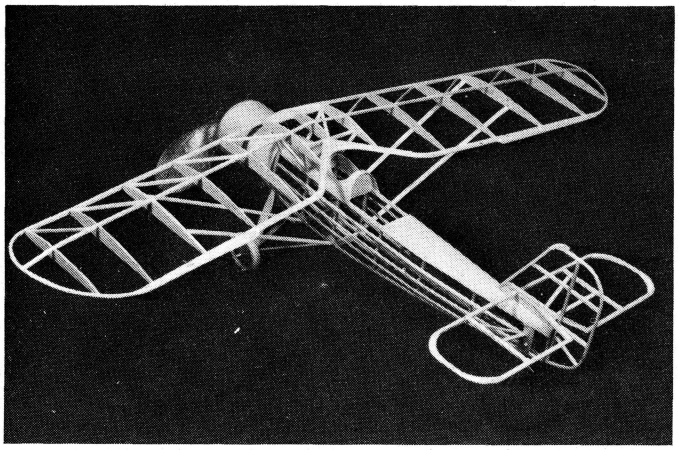


9. The wing and tail are built over the plan in the same way as the fuselage. Construction of these components varies in detail from model to model, and variations are explained in greater detail in the articles and plans of the individual models.



10. Landing gear wires can be attached very efficiently to the airframe by means of silk or nylon patches saturated with quick-drying epoxy glue.





LAMINATED OUTLINE CONSTRUCTION

Wing tip and tailplane outlines may be either built up from separate sections as shown on the plans in this book or they may be formed from laminated strips.

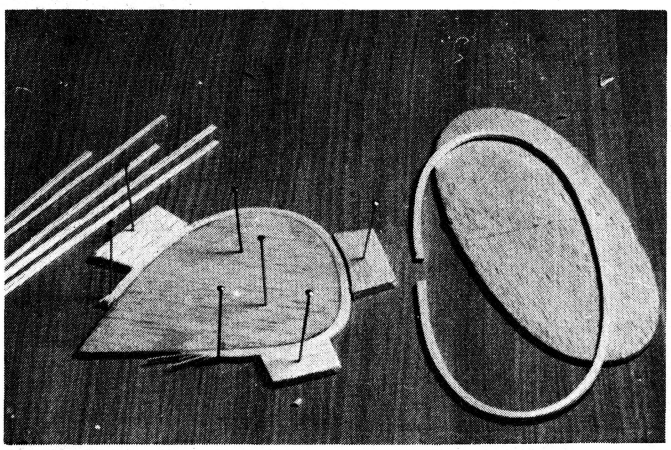
Although perhaps a little more time is needed to produce a laminated outline, it is certainly a very neat form of construction and if properly done, it results in a resilient, strong but very light construction.

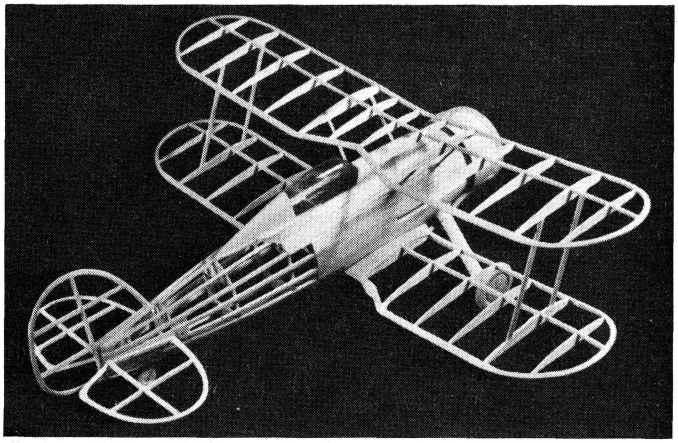
The method is really quite simple. First of all, a template must be cut from 1/8 sheet balsa approximately 1/16 in. smaller all around than the outline of the finished component. This is waxed around its edge using an ordinary candle and pinned down to a waxed surface or to a flat plastic film covered surface. Five strips 1/16 in. wide are now cut from a sheet of 1/64 balsa. They should be long enough to go around the whole template with about an inch to spare at each end.

These strips should be soaked in a solution of P.V.A. white glue and water of a cream-like consistency until completely saturated. They are then pressed together and carefully formed around the template, being careful to maintain every piece in contact with the next one and holding it firmly in place by means of small pieces of 1/16 sheet each held with a pin as shown.

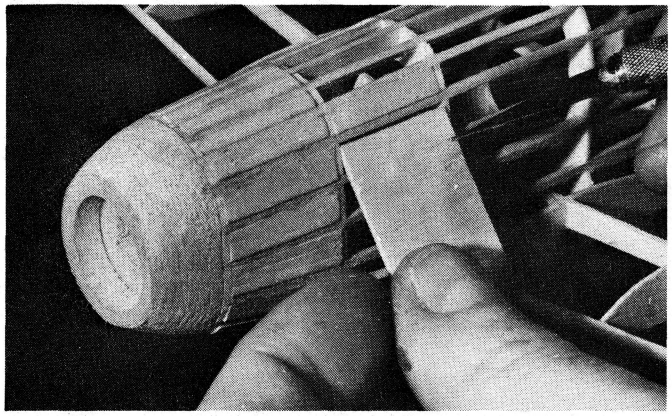
Allow to dry thoroughly and then remove carefully from the template, cut to size and glue in place, overlapping the members to which it is attached with a scarf joint.

The constructional photograph shows a fin and rudder outline being made in the way described above and the airframe picture shows the completed component in place on a Heinkel He. 46. The wing tips of this model are also constructed in this manner.



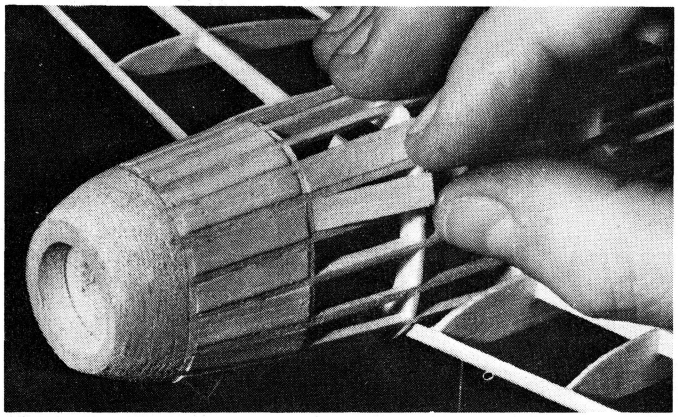


The outlines of the complete tailplane components, and all the wingtips of the Gladiator are formed from laminated 1/64 x 1/16 strips.

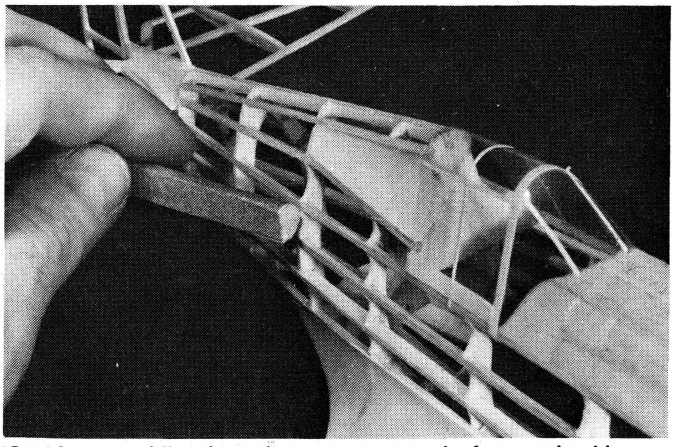


11. Filling in the nose with pieces of 1/16th sheet needs a certain amount of care but is well worth the effort involved. You need the weight in the nose and the in-filling increases the strength of the model enormously in addition to producing a beautifully smooth and realistic structure.

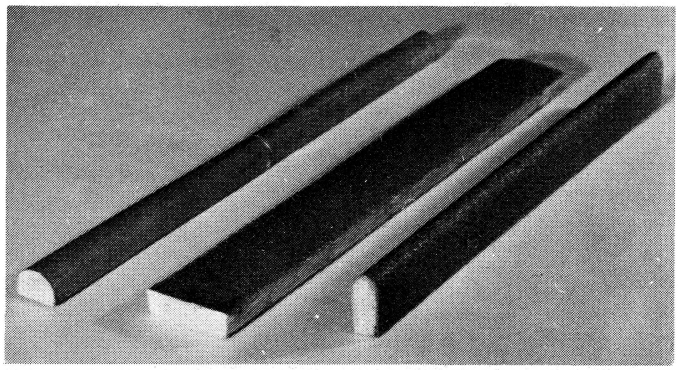
Cut a piece of 1/16th sheet to the correct width between two formers with the grain running along the length of the fuselage. Offer it up to a stringer and sand the edge until a neat fit is achieved. Lightly "nick" the sheet to indicate the width to which the insert must be cut to exactly fill the space between two stringers.



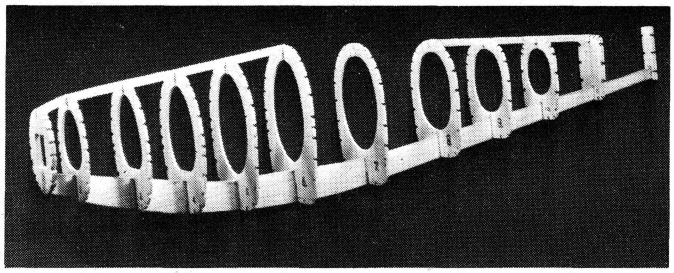
12. Using a steel straightedge cut between the two "nicks" and check the resulting insert for fit. Try to make the cut in such a way that each little panel is slightly oversize so that by careful sanding it can be made to fit exactly without leaving gaps in the structure. Note that the inserts are edged with glue before finally pressing into place. As can be seen in the photograph, each insert is allowed to stand very slightly "proud" of the stringer surface so that proper curvature can be introduced when the nose is finally sanded down.

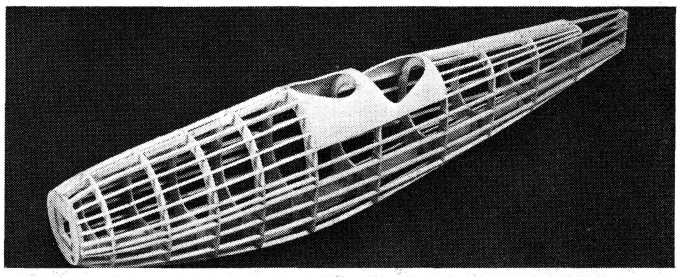


13. After assembling the various components, the formers should be relieved slightly between the stringers wherever tissue covering is to be applied. This is most easily accomplished by the use of a half-round piece of 1/4" x 1/4" balsa around which a strip of fine sandpaper has been glued.



14. A good finish depends very much upon accurate workmanship and the careful use of sandpaper to achieve a regular and smooth structure prior to covering. Sandpaper used "loose" in the hand is a very poor tool. Time spent in preparing a selection of "sanding sticks" is well worthwhile. Here is a selection of three shapes . . . you will think of many others. Make a selection of each shape and cover them with different grades of sandpaper. In some cases you can use a different grade on each side of the same stick.





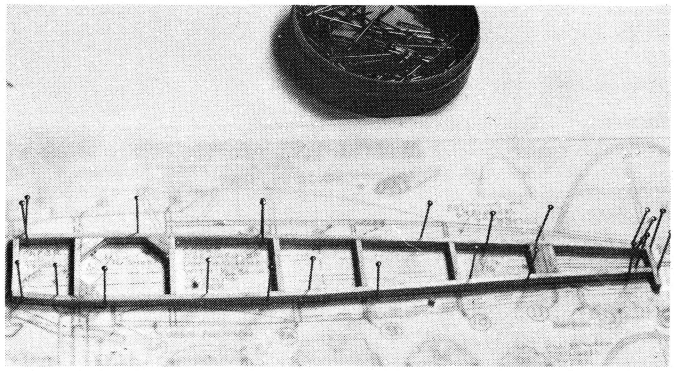
KEEL FUSELAGE CONSTRUCTION
Another method of building fuselages is by the "keel-and-former" system.
A deep 1/16 sheet balsa lower keel acts as a built-in jig onto which the complete formers are slotted. They are positioned upright by a smaller section upper keel before placing the stringers in position in pairs . . . one on either side of the fuselage at the same time in order to avoid distortion.

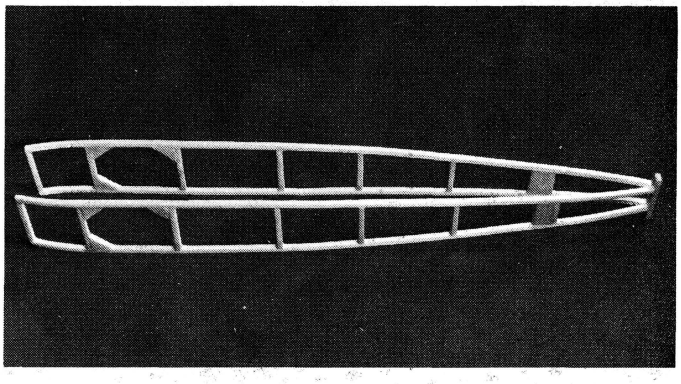
touchers.

It is, of course, possible to get high performance from a fully decorated model by disposing with the rubber motor and using instead one of the remarkable little Brown CO_2 engines. Details of a typical conversion are shown on the Spitfire drawing and this principle can be adapted to other models in this book. As a rubber-powered model, the Spitfire would stay aloft for about half a minute maximum. By using the Brown engine, the same airframe will now remain airborne for upwards of 1-1/2 minutes, and despite its complete decoration the all-up weight has been reduced by about 1/4 oz., which has significantly improved the glide. My own philosophy is to attempt to achieve, within an acceptable maximum weight, the highest possible degree of realism, and I accept a performance drop providing the flight pattern is realistic, stable, and consistent.

The only way to achieve an acceptably high degree of realism in models of this size is to employ an air brush and apply the lightest of coats possible . . . just sufficient to produce an opaque tissue surface.

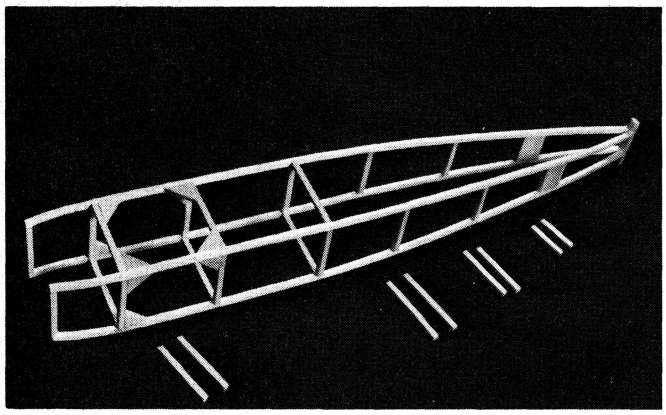
The series of photographs in this article illustrate covering techniques which I employ when applying Japanese tissue. This material is not only exceptionally light in weight, but is very smooth and has a distinctive grain which should always be arranged so that it runs along the length of a component (i.e. from root to tip of a wing or from



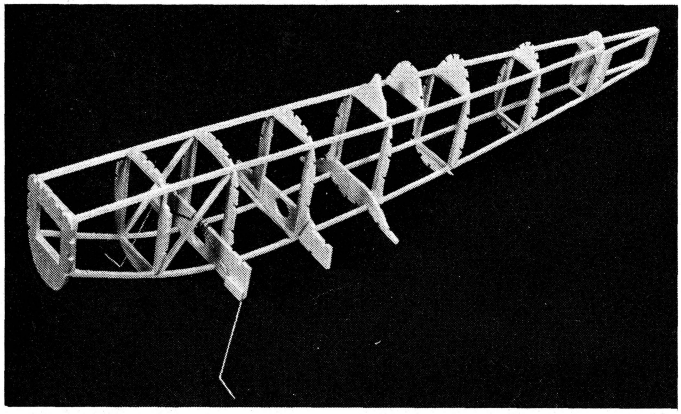


BOX FUSELAGE CONSTRUCTION:
1. Cover the plan with a thin plastic film sheet and lay down the main longerons, holding them in place with pins placed on either side, not THROUGH them. Glue the upright members in place between the top and bottom longerons. Build a second side directly on top of the first one and this will ensure absolute uniformity. Remove the pins, lift the two sides when completely dry and separate them carefully with a razor blade.

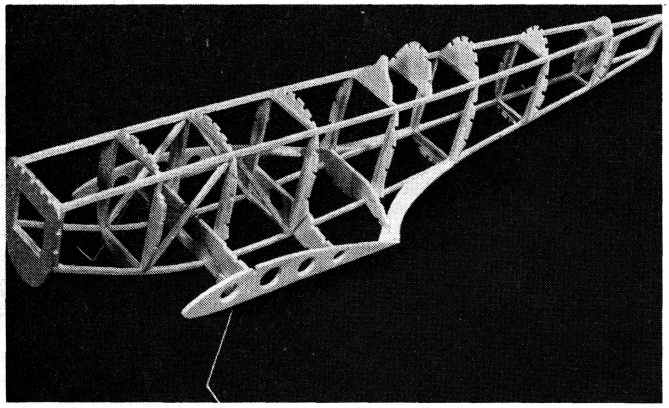
2. Carefully bend the completed sides to conform to the correct line in plan view. Use steam from a boiling kettle if a sharp bend is required. Now glue the sides together at the stern posts.



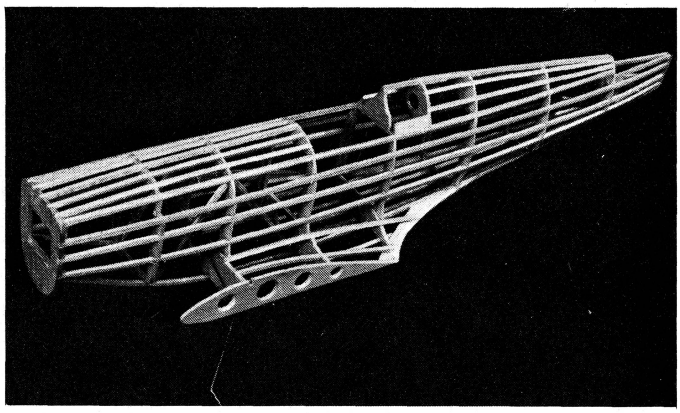
3. Carefully cut the cross pieces to the correct length in pairs. Glue the longest ones in place holding the fuselage sides together with a thin rubber band if necessary. When dry, insert the remainder of the cross pieces ensuring that the complete structure is kept perfectly "square" in cross section.



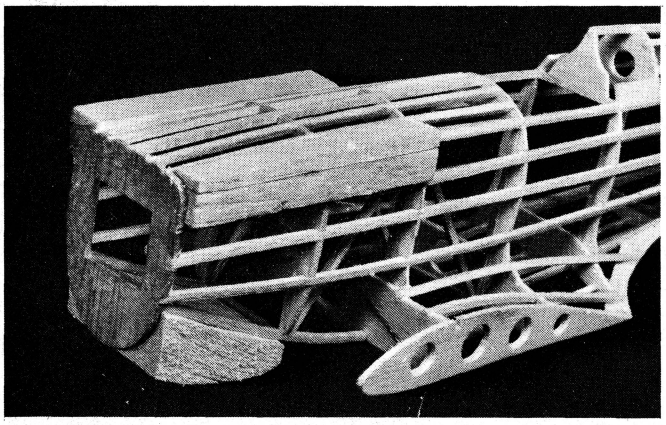
4. Quarter formers are now glued in place on top, bottom and sides of the completed box. Except in the nose, where strength is essential and weight not so important, these quarter formers can be of very light material. In the case of models of the size in this book, 1/16 sq. balsa is used for the basic box, and for the stressed formers 1/16 sheet is used. For the remainder of the quarter formers, 1/32 sheet is adequate.



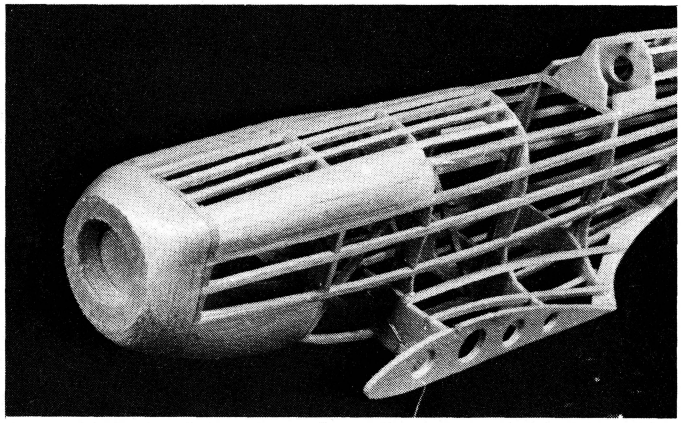
5. In the case of a Spitfire fuselage constructed in this manner, it is best to build in the wing root with the basic fuselage. If glue is used sparingly and wood is carefully chosen, a very strong and light airframe results. Note that the box longerons now form four of the fuselage stringers.



6. Next, 1/16 sq. stringers are added in the same sequence as for a half shell constructed fuselage.



7. Where blocks may be required to achieve a nose contour, these should be glued in place and carved and sanded to shape "in situ."



8. The engine cylinder head fairings may, on the Spitfire, be made from block balsa as shown here or, with the stringer formation possible with the half shell fuselage shown in the plans, 1/16 balsa inserts may be used.

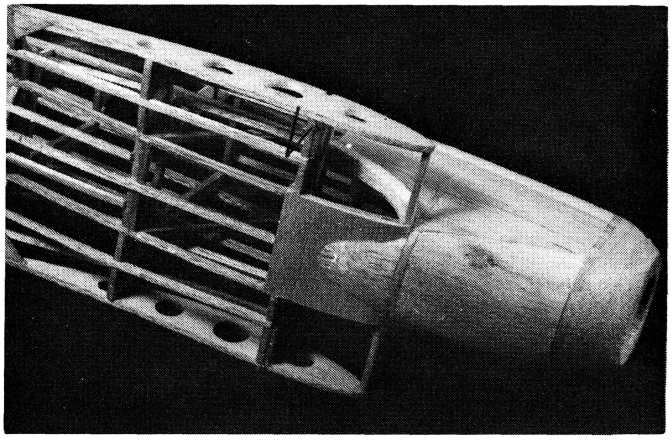
nose to tail of the fuselage). It also has a very low absorbancy and consequently soaks up a relatively small amount of dope, thereby saving quite a lot of weight.

Having attached to the airframe all the tissue covering as shown in the accompanying photographs, the tissue must be tightened before applying clear shrinking dope. The gentlest method of tightening tissue is to hold it in the steam from a boiling kettle. A considerably amount of control can be exercised over the degree of shrinkage achieved by this method, which is particularly suitable for lightweight airframes.

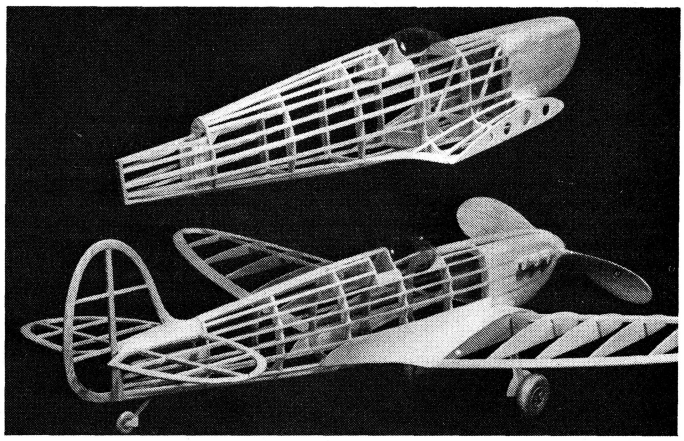
Where the strength of the airframe permits, most people prefer to water shrink the tissue by means of spraying it with a mist of warm water, either from a perfume spray or with the air brush. Always allow the moistened tissue to dry naturally at room temperature and do not attempt to accelerate this process by holding the model near a radiator or other heat source.

When the tissue has completely dried out, it will be found to be entirely smooth and wrinkle-free. It is now ready for clear doping.

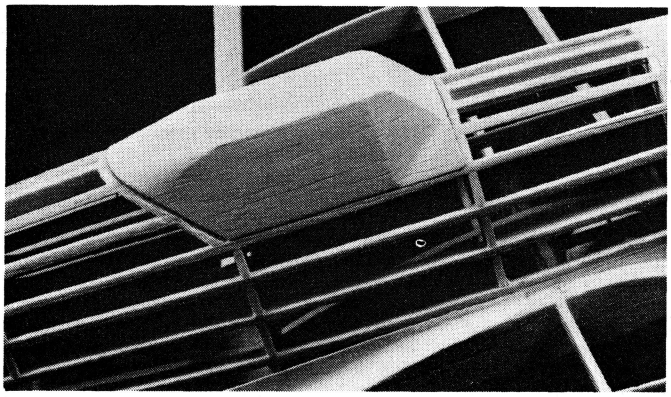
My own preference is cellulose acetate or cellulose nitrate dopes for



9. After fitting the remainder of the nose filler inserts, the complete section should be sanded smooth to blend in cleanly with the nose block. This photograph also shows how the underside of the fuselage nose may be blended into the wing leading edge using 1/64 sheet balsa on the wing and very soft 1/8 sheet for the tongue shaped fairing piece.

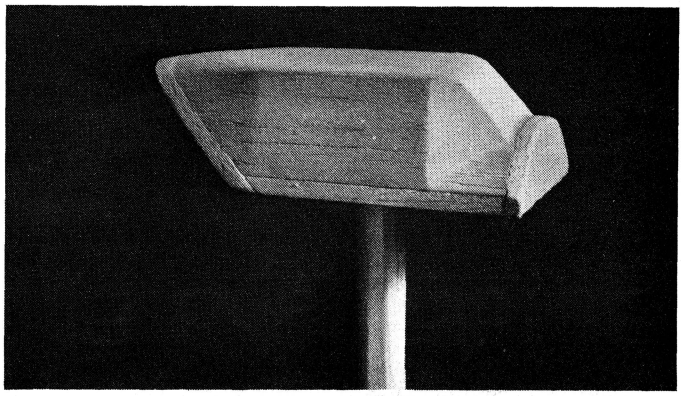


10. Shown here is the completed Spitfire built according to the book plans (bottom). Above it, is shown the same size fuselage constructed by the box method. Although somewhat more tedious to build, the box-built fuselage can be significantly lighter and stronger than the equivalent conventional half shell job.

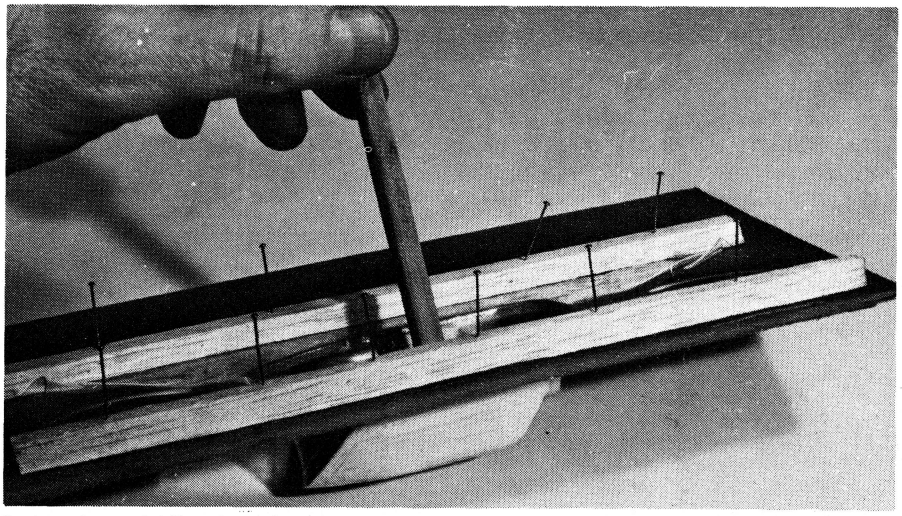


CANOPY MOULDING

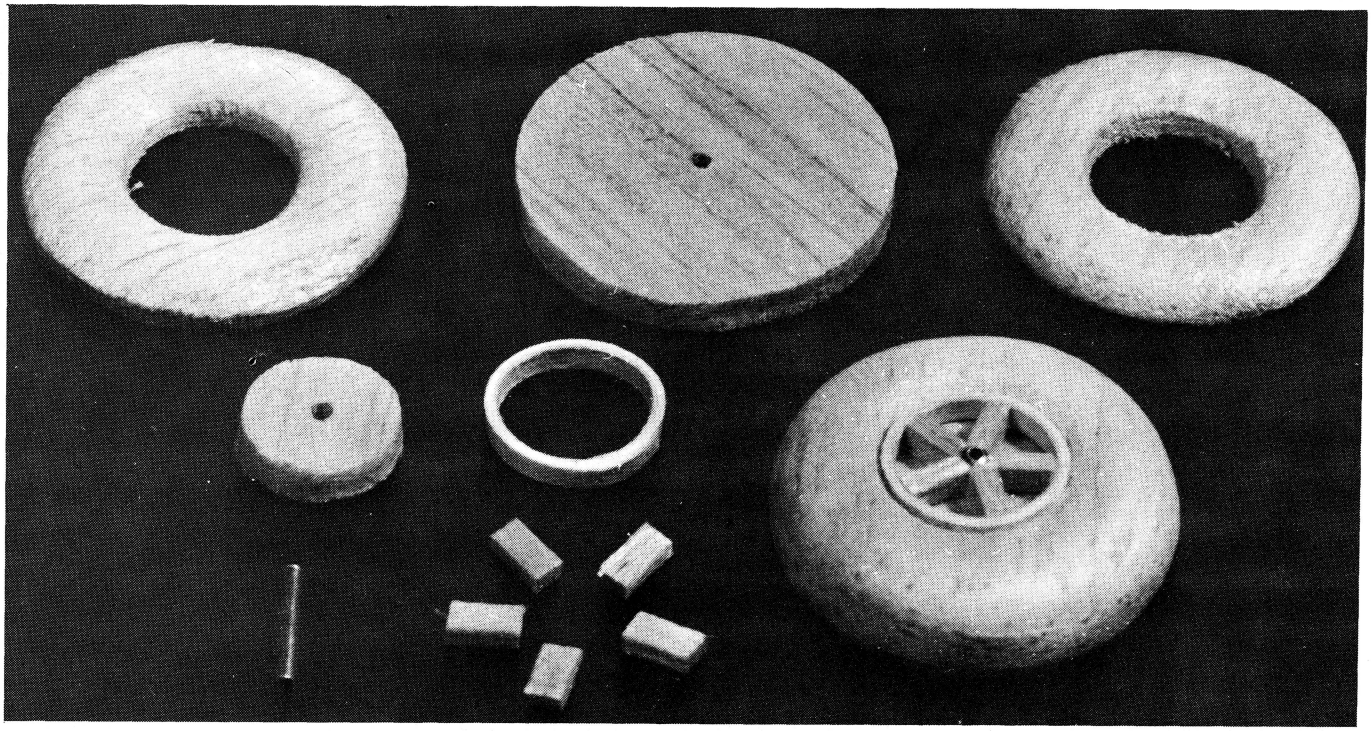
1. Carefully carve a block of balsa to the shape of the finished cockpit canopy so that it fits neatly into the cockpit area.



2. Add pieces of 1/8 sheet to the front, back and underside of the canopy block and blend them into the correct section. When dry, pierce the underside of the block and insert a 6 inch length of 1/4 inch diameter dowel.



3. In a sheet of 1/8 inch thick hardboard or plywood, cut a hole conforming to the cockpit plan view and roughly 1/8 inch oversize all round.
Place over the hole a sheet of 7 thou. (.007) acetate sheet and hold it in place with two strips of 1/4 sq. balsa and pins.
Heat the acetate by holding it in front of an electric fire until it becomes quite "floppy" and begins to give off a little steam.
At this point the balsa canopy form must be instantly plunged into the cut out hole, carrying the acetate down and forming it into a transparent canopy. Hold it still for a few seconds unti the acetate cools.
4. Remove the pins and lift the moulding clear. It can be trimmed to shape using a pair of small scissors allowing about 1/16 inch overlap to stick to the model.
A white or milky appearance on the moulding indicates that the acetate was insufficiently heated or was allowed to cool too much when the balsa form was pressed into it.
5. The neatest method of fixing the canopy is to hold it in position with a strip of adhesive tape and then run some clear dope around the edge of it. Allow the dope to dry completely before removing the tape.



BALSA WHEELS

Very lightweight, realistic wheels can be easily constructed in the following manner:

1. Cut three discs of balsa which, when laminated will equal the thickness of the finished wheel.

2. Cut out the centers of two of the discs and sand one face of each resulting ring to a half-round section on one side only.

3. Glue these three pieces together, ensuring that the grain directions are crossed.

4. The hub construction will vary from model to model, but a typical cast spoke type hub such as used on the Spitfire, Hurricane and ME 109 is illustrated. A 1/16 thick paper ring is formed around a suitable circular former by taking a 1/16 wide strip of stiff paper about 4 inches long, soaking it with balsa cement and winding it around the former and holding the end in position until the cement starts to set.

5. The paper ring just formed is placed in position on one side of the wheel and a balsa disc is glued to the opposite side to represent the brake drum.

6. A short length of brass or aluminum tube is now placed centrally through the wheel and fixed the Epoxy glue.

7. "Spokes" are now cut to length from 1/16 strip, placed in position around the tube, and glued in place with Titebond.

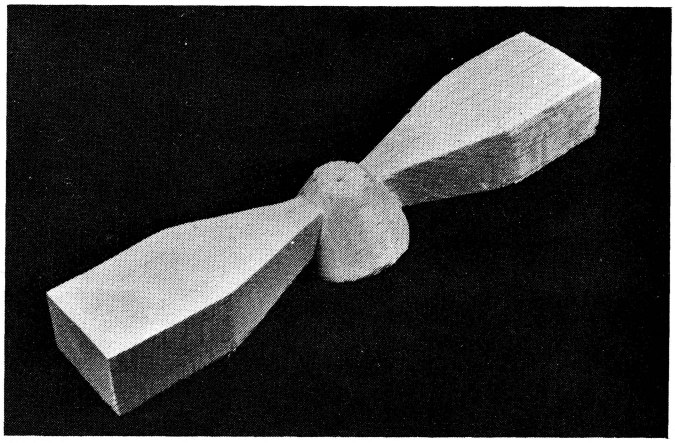
8. When the whole thing is dry, the wheel should be checked for concentricity by spinning it on a pin. The perimeter should be sanded to achieve a tire profile and then the entire wheel is given two coats of sanding sealer. When dry, it is lightly rubbed down with fine abrasive paper prior to painting.

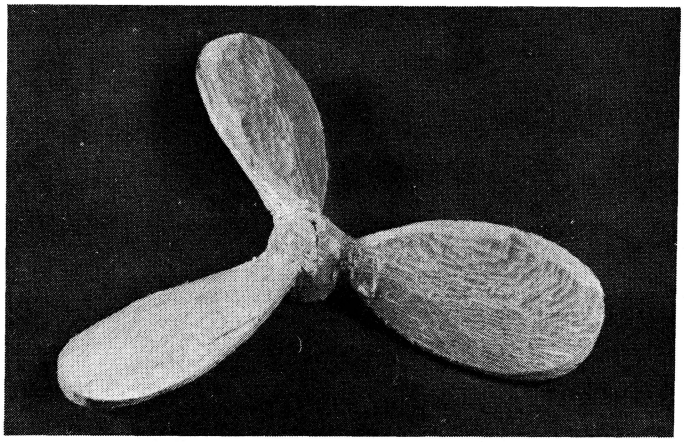
finishing. It is important to ensure that all dopes used are of a similar type; that is to say, you must avoid mixing, for instance, butyrate with nitrate or acetate, and also, keep nitrate and acetate well apart.

Using a 1/4 inch flat camel hair brush, apply to the water shrunk tissue two coats of clear shrinking dope diluted with the appropriate thinners to the consistency of thin cream. It is impossible to give precise proportions of dope to thinners since there is so much variation in the consistency of different makes of dope.

When dry, very lightly and carefully go over the airframe with a piece of No. 600 grit wet-or-dry abrasive paper to remove any roughness which occasionally appears on the tissue surface after the application of clear dope. When you are satisfied that the whole model model is smooth as it can be made, you may apply the color dope. Never under any circumstances apply this with a brush because the additional weight almost inseparable from such application will severely reduce flight performance.

Color dopes used with the air brush should be once again thinned out to a





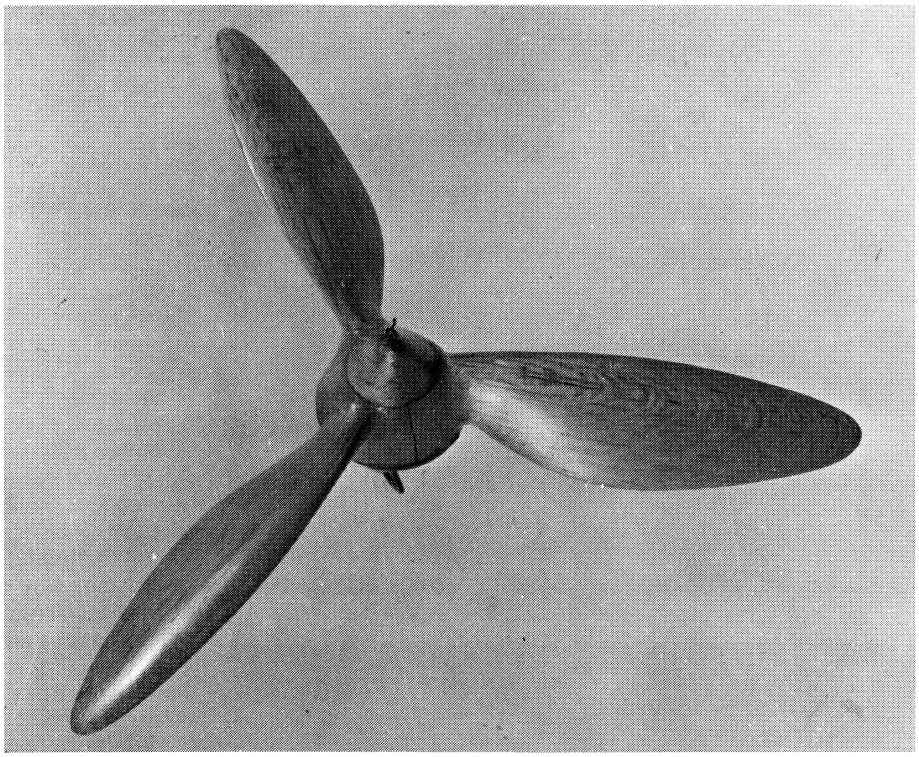
WOODEN PROPELLER

1. Propeller carving is not as difficult as many would have you believe. Success depends upon starting properly with a block of straight grained hard balsa and cutting the propeller blank exactly to the shape shown in the drawings.

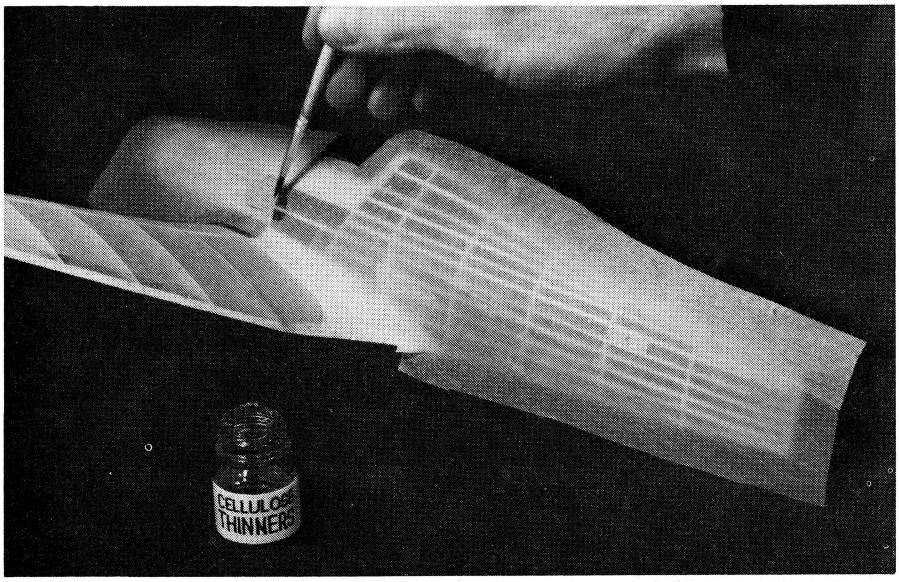
The spinner is best carved from the same block as shown. Drill a 1/16 hole through the center of the block and ensure that it is perfectly "square" with the propeller faces before proceeding further.

2. Rough-carve the blades, using the edges of the blank as a guide. Carve the front face first and then the rear face, leaving the blades thicker at the hub than at the tip.

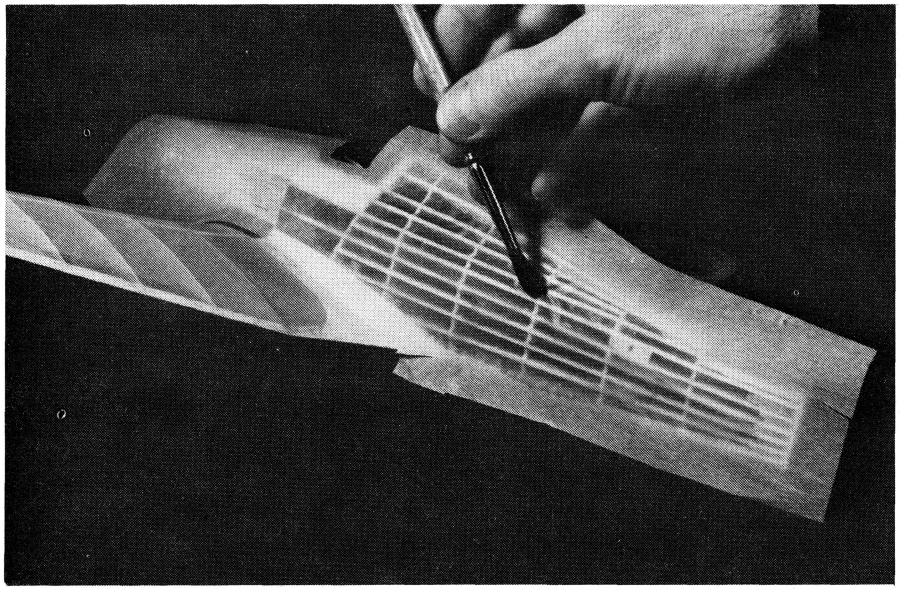
In the case of a three bladed propeller, the individual blades should be joined at the hub using epoxy adhesive and reinforcing the joint with a plywood disc at front and back.



3. Sand the propeller to shape with coarse sandpaper and undercamber the rear blade faces. Use progressively finer sandpaper until a fine finish is achieved. A brass tube should be epoxied through the hub and the propeller balanced by pivoting it on a piece of suitable wire. Finally, three or four coats of sanding sealer should be applied and rubbed down to achieve a grain-free surface prior to spraying matt black.
Various free-wheeling systems are shown on the plans in this book.



15. When the airframe is complete, give it a coat of sanding sealer on all the surfaces which are either to be painted or covered with tissue (not, for instance on the inside faces of the formers or ribs - only on the outside edges). Two coats of sealer should be given to the nose. Note the two small cowling bumps on the Hurricane nose shown in this picture. They are made and shaped from soft 1/16th balsa and attached prior to applying the sanding sealer. Larger projections . . . such as exhaust pipes . . . are made and checked for fit at this stage, but not finally glued in place until after the covering is complete.
If a proprietary brand of sanding sealer is not available locally a passable substitute can be produced with very fine talcum powder in clear dope.
The airframe, now with a coat of sanding sealer on its outside surfaces, is lightly sanded with very fine paper only sufficiently to remove the slight "fur" which the sealer raises on the wood.
Using Japanese tissue, a panel is cut to size leaving approximately 3/4 inch all around oversize Semi-wet covering produces the neatest results although a certain amount of skill is required before perfect results can be achieved. The following photographs illustrate the technique.
16. Attach the tissue at the point shown at the rear of the sheeted nose area using cellulose thinners which will, on soaking through the tissue, activate the sanding sealer and when dry the tissue will be firmly attached to the wood. The advantage of using this method is that should a mistake be made, the covering can be lifted without damage simply by re-soaking with thinners.

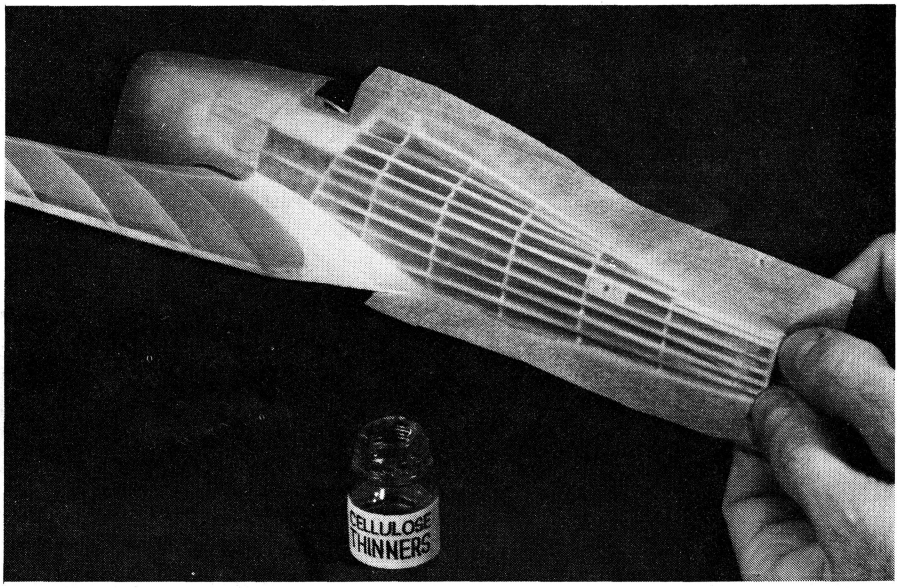


17. Take a soft camel brush . . . about a No. 4 or 5 . . . load it with water and carefully moisten the tissue aft of the attachment point but leaving the edges and extreme tail dry where they will be attached to the frame. Moistening the tissue in this way expands it and allows it to conform to a compound curved surface.

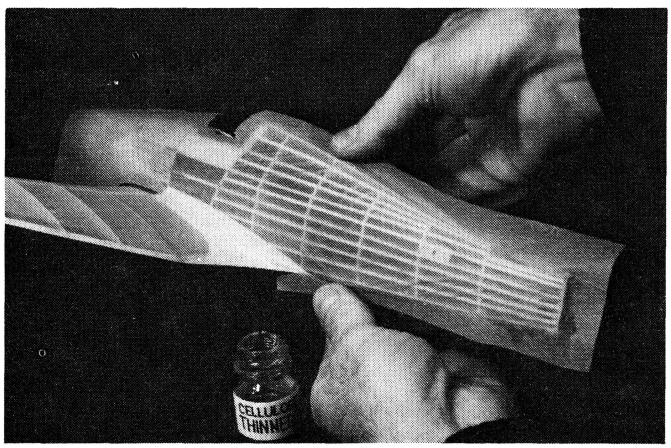
fairly watery consistency. Spraying should normally be done at between 3 and 6 inches from the model and this is shown in one of the accompanying photographs. Try to develop a spraying technique which allows the dope to dry almost as soon as it hits the model. If the dope is too thin it will tend to run and the coverage will be very poor. If, on the other hand, it is too thick you will get an "orange peel" reticulated surface and, more important, a lot of unnecessary weight. Only by practice can a good technique be developed.

It is not easy to obtain ready mixed camouflage colors in cellulose based dopes. At one time, every model shop shop carried a very wide range of such material but today it has almost entirely disappeared.

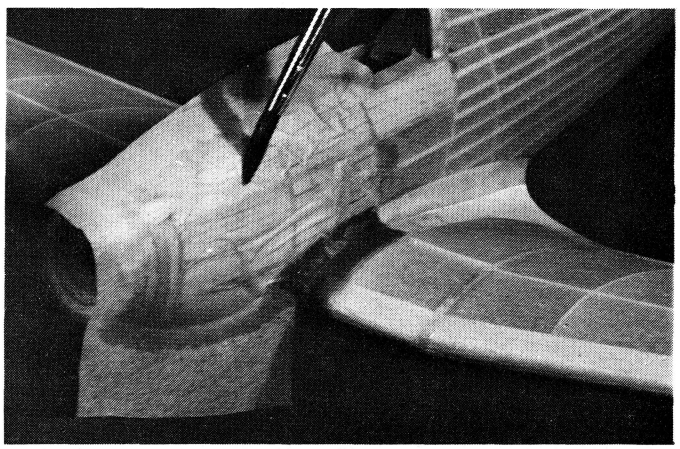
British camouflage dark earth and dark green are still bottled by the Titanine Company in England in both glossy and semi-matt finish. The latter is a really first class material and highly recommended. It is unfortunate that other colors are not available in this range. Two oz. bottles can be obtained from Messrs. Henry J. Nichols & Son Ltd., 308 Holloway Road, London, N7, 6NP, England.



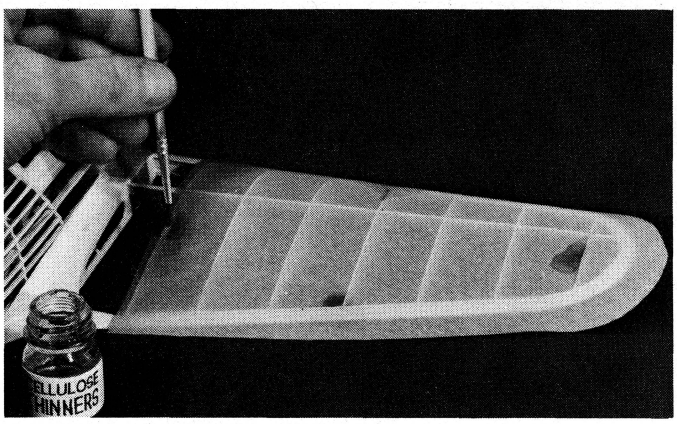
18. Gently ease the tissue back at the tail-post stretching it only sufficiently to enable the tissue to form itself round the fuselage contours without wrinkling. The correct tension thus applied can only be learned by trial and error. Now attach the tissue to the tail-post with thinners, holding the tension on the tissue until it is firmly fixed.



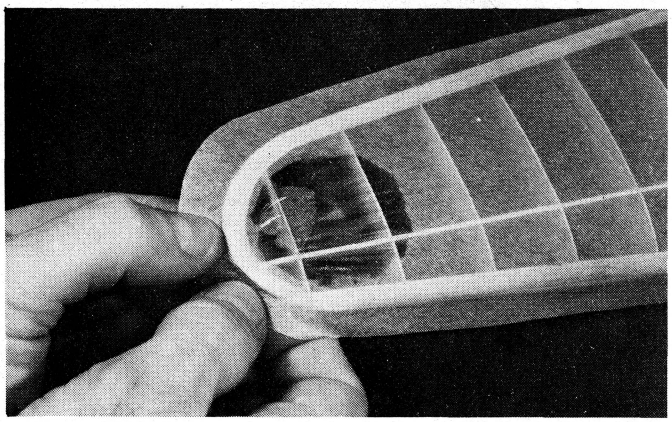
19. If the tissue has started to dry out, re-moisten it. Now gently ease the tissue in the manner shown, approximately mid-way between the fore and aft attachment points, sticking it to the upper and lower keels with a spot of thinners just about where the thumbs are in the picture. When secure, run thinners along the remaining edges, gently easing out any wrinkles as you go.



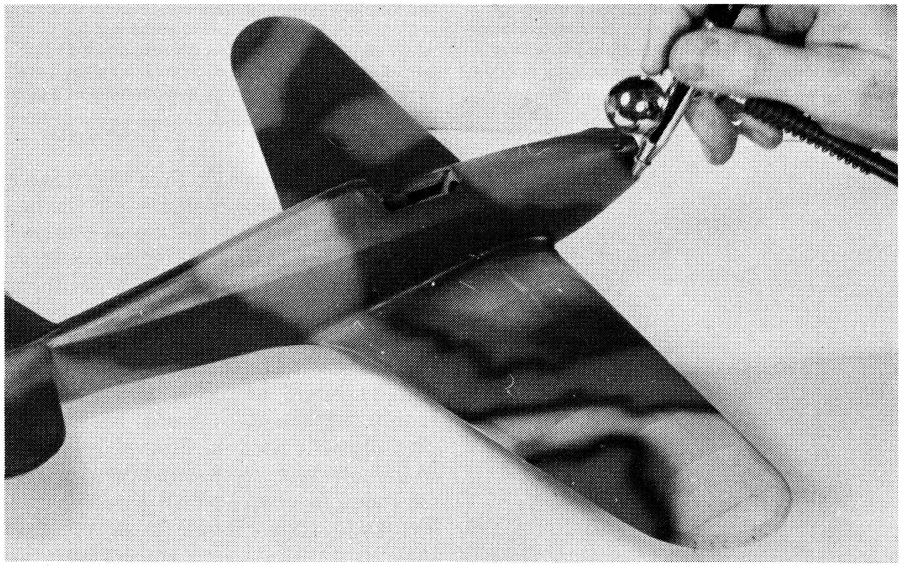
20. Moisten the tissue over the sheeted nose area, with water. Gently smooth it down to remove the wrinkles and press it carefully over cowling fairings etc. Now flood the whole area with cellulose thinners while the tissue is still wet. There is no need to press it in place after this process, and as the water drys out, the tissue will be found to have bonded itself very securely to the wooden surface. Any "blushing" which takes place will disappear when sanding sealer is applied over the tissue in these sheeted areas, and a superb finish will result when the sealer is smoothed with very fine abrasive paper.

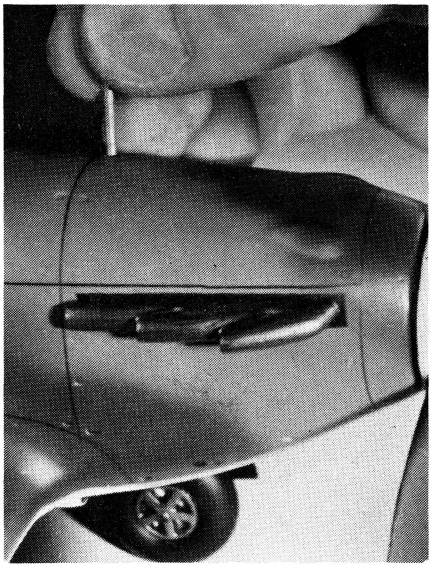


21. Wings are covered "dry" where no compound curvature exists. Attach the tissue with thinners first at the root and then at the tip rib before sticking it to the leading and trailing edges with spots of thinners as shown above.
When these spot attachments are dry, the tissue is gently stretched into the "corners" of the structure and thinners run around the frame to secure it in place.



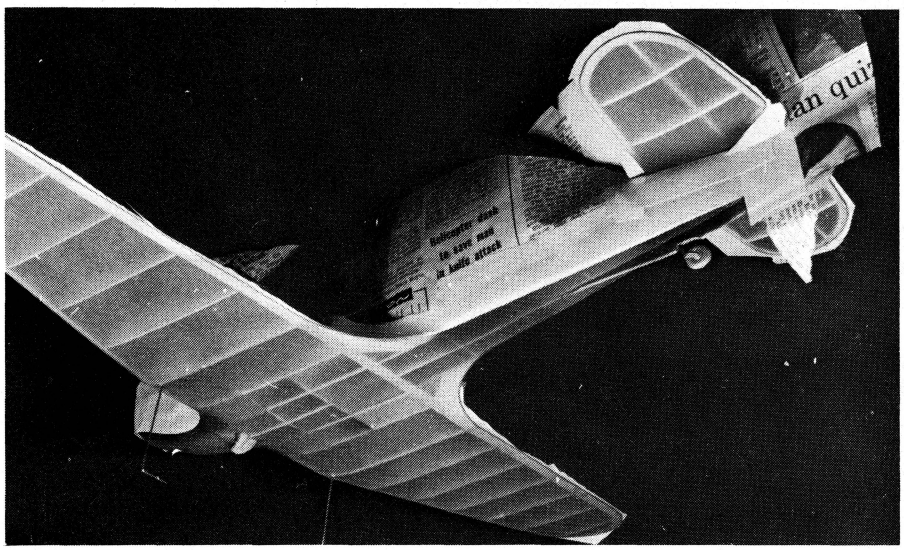
22. Now lift the tip rib attachment with another spot of thinners and moisten the area where a double covering curvature must be achieved using clean water on a soft camel brush. Leave the edges dry and gently ease the tissue down towards the wingtip outline attaching it with thinners.
All surplus tissue may be trimmed off flush with the structure outline by running one of the fine sanding sticks along the edge at right angles to the surface. Dry-covered areas are now lightly sprayed with water to shrink the tissue prior to doping.





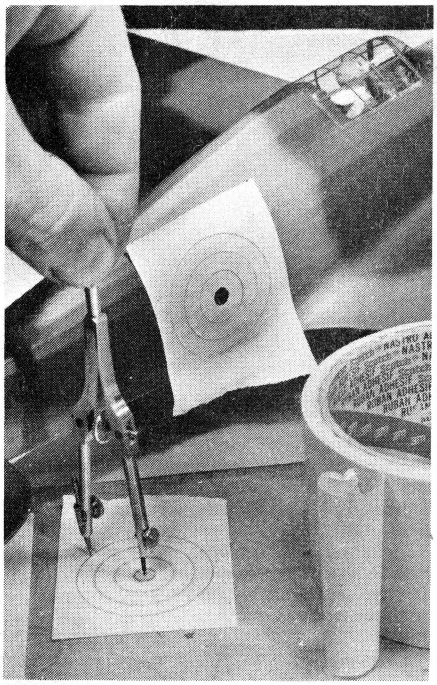
FINISHING

1. When the covering is complete and has been lightly sprayed with water to shrink it, the whole model is given two coats of thin clear shrinking dope. Sheeted areas like the nose are given two further coats of sanding sealer and lightly rubbed down in order to achieve a really smooth and grain-free surface.
A very thin coat of colour dope may now be applied, using the lightest of sprays from an artist's air brush. In the case of a camouflaged model, the outline of the shadow shaded areas are first "drawn in" with the air brush before filling in the colour areas as shown above.



3. (Above) Panel lines may be drawn onto the model using strips of thin plastic as guides for the draftsman's ruling pen, which is charged with dark gray dope.
On sheeted areas, cowling fasteners may be simulated with the sharpened end of a brass tube gently pressed into the surface, at the same time slowly rotating it between thumb and finger as shown.
Exhaust pipes should be painted with a mixture of black and brown matt dope to which has been added a little silver.

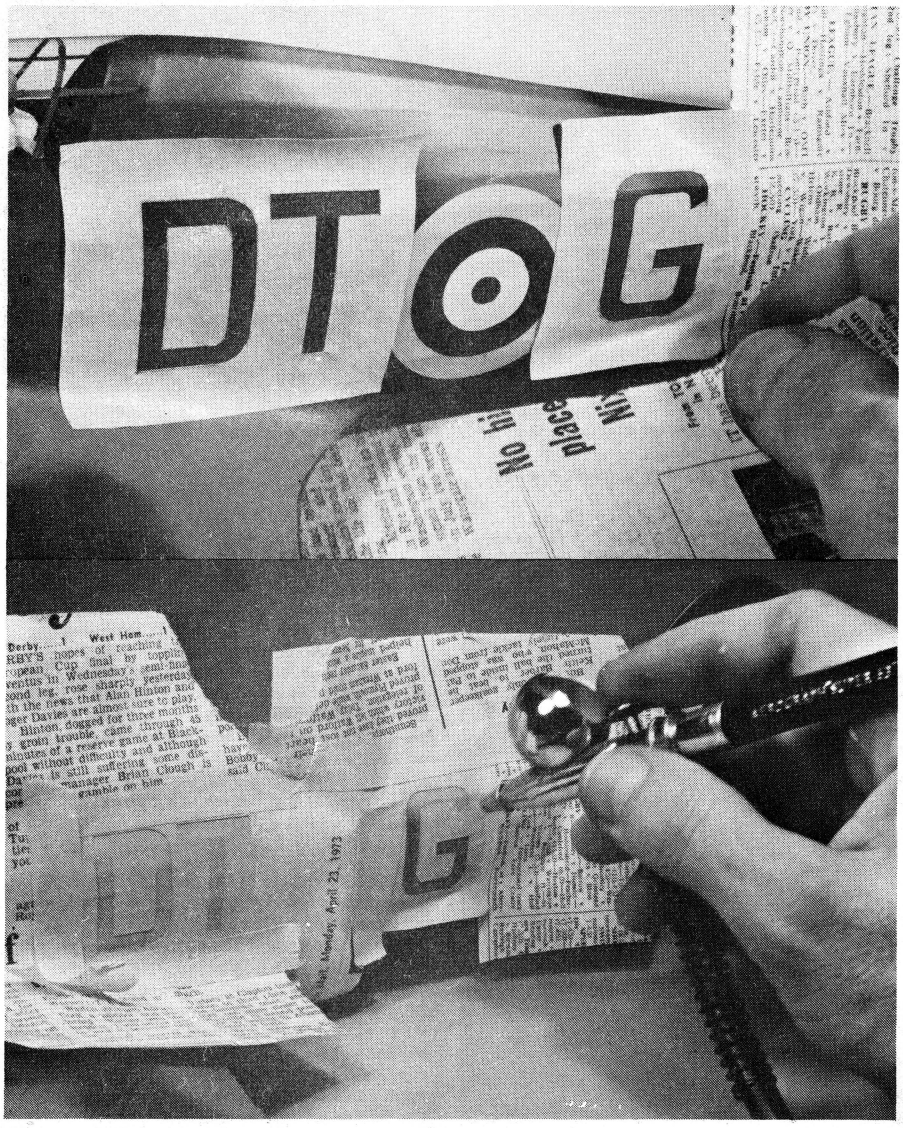
2. (Left) Where a sharp dividing line is required between colours, the already doped areas must be protected.
Strips of draftsman's adhesive masking tape are carefully positioned along the colour dividing lines and newspaper is used to shield the painted parts.
After spraying the unmasked areas, the masking tape should be very carefully removed by peeling it gently back on itself. Never lift it from the tissue at right angles or you will run the risk of damaging the surface.



MARKINGS

1. Transfers may, of course, be used whenever these are available, but there is certainly nothing to equal painted lettering and roundels, which are not difficult to produce if the following procedures are followed. Roundels are cut from draftsman's masking tape which is stuck to a sheet of plastic laminate. Use a pair of springbow dividers with one pin sharpened to a knife - edge using a fine oilstone. The resulting circles may then be carefully peeled off the laminate and placed in position on the model.

2. One piece at a time is now removed and the respective colour sprayed. The tape is now replaced and the next piece removed for spraying and so on. This picture shows the completed roundel being revealed as the tape is removed together with the surrounding protective newspaper.



Fernando Ramos is Free Flight Scale editor for MODEL BUILDER Magazine, also newsletter editor for the well known Rockwell International Flightmasters, an all-scale model club located in Southern California, USA. A prolific builder of rubber, gas, and CO_2 scale F/F models, he strongly recommends the use of the Floquil brand of paints which are primarily marketed for model railroading. The pigment used in Floquil is ground extremely fine, so that it takes very little paint to cover, which saves weight. Fernando adds Floquil to a very thin mixture of nitrate dope and thinner (50-50) and sprays it on the model. For small parts, such as struts, Floquil is brushed directly on the bare wood, full strength, sanded, and a second coat added. No more is needed because of its excellent filling and hiding qualities. The paint comes in an almost endless variety of colors, though they are listed in railroad terms, such as Roof Brown (close to WW I khaki), Pullman Green (olive drab), etc. Mixing colors will get you most anything you want.

For more hints on the use of Floquil, and model finishing in general, you may write to Fernando at 19361 South Mesa Drive, Villa Park, California 92667, USA.

3. Lettering and other non-circular decoration uses basically the same principle except that the design is first traced onto the surface of the draftsman's tape, the outline being cut with a modelling knife before removal from the plastic laminate.
Before spraying be certain that the edges of the masks are well stuck down to the model to prevent color creep.