SCALE MODEL AIRCRAFT CONSTRUCTION PROCEDURE

by

ROBERT W. HAMBROOK
Executive Secretary
Model Aircraft Project Committee
and others

1942

FEDERAL SECURITY AGENCY
PAUL V. McNUTT, Administrator
U. S. OFFICE OF EDUCATION
JOHN W. STUDEBAKER, Commissioner

Misc. 2946

FOREWORD

Accurate scale model aircraft have proved the most helpful training device for the recognition of aircraft, range estimation, and determination of cones of fire. For this reason the Navy, the Army, and civilian defense groups, and others need thousands of them. This will require the modeling of planes of many types: Fighters, scouts, fighter bombers, bombers, torpedo carriers, and commercial planes. These are to represent the planes of the United States, England, Canada, Australia, Holland, Russia, France, Germany, Italy, Japan, and other nations now engaged in this war.

In December 1941 the Secretary of the Navy asked the U. S. Commissioner of Education if the nation's schools could make 500,000 scale model airplanes "for such purposes as recognition, range estimation, and determination of cones of fire." Since that date a number of conferences have been held to determine the feasibility of such a program and desirable procedure to be followed. After careful consideration it was decided that these scale model aircraft could be made through the utilization of our nation's schools.

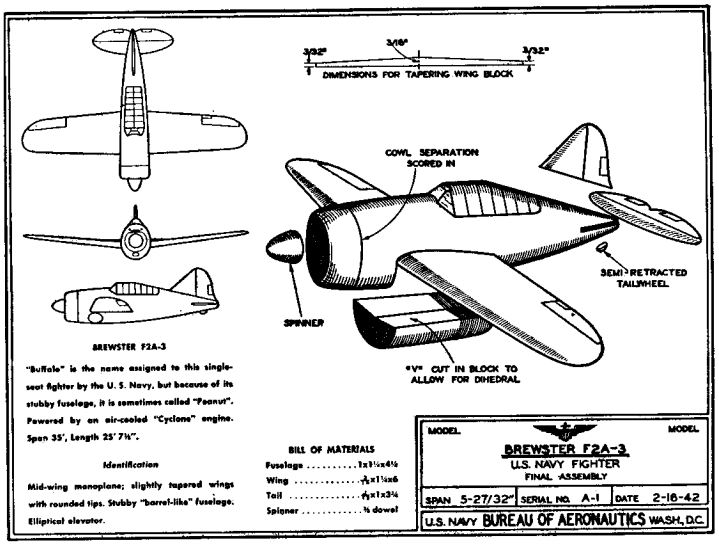
Under the plans which have been developed the U. S. Navy, Bureau of Aeronautics, is supplying authoritative drawings and plans. The U. S. Office of Education prepared such educational and informational material as required.

This booklet has been prepared by Robert W. Hambrook, U. S. Office of Education, who is Executive Secretary of the Model Aircraft Project Committee, with the assistance and advice of Paul Garber, Assistant Curator, U. S. National Museum, now with the U. S. Navy Bureau of Aeronautics, Washington, D. C., Albert L. Lewis, Director, Air Youth Division, National Aeronautic Association, Washington, D. C., Russell W. Nichols, Member of Education Committee, Academy of Model Aeronautics, National Aeronautic Association, Washington, D. C., John H. Williams, Manual Arts Instructor, Powell Junior High School, Washington, D. C., and Jack M. Kimbell, Illustrator, Federal Security Agency, Washington, D. C.

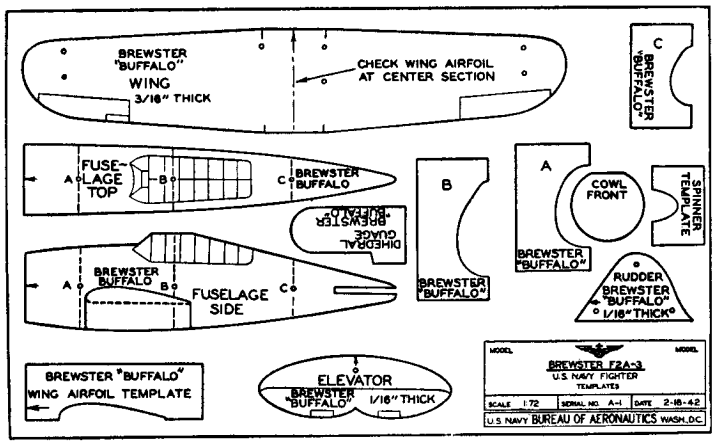
J. C. WRIGHT
Assistant U. S. Commissioner for Vocational Education and Director, Model Aircraft Project

Washington, D. C.
February 18, 1942

CONTENTS



Plan "A"



Template "B"

CHAPTER I

SCALE MODEL AIRCRAFT CONSTRUCTION

INTRODUCTION

The United States needs scale model planes for the emergency. The models are not for placement in some museum as show pieces or to represent the result of leisure time activities of aviation enthusiasts. They are to be used specifically for the training of military and civilian pilots, airplane spotters, and thousands of others who are concerned with the recognition, range estimation, and determination of cones of fire of planes of the United Nations and Axis Nations.

Students of grade and secondary school age, and adults throughout the nation will learn fundamentals of aircraft identification and become experts in this field.

This program gives the youth of the United States a definite responsibility in the war effort, a responsibility which should not be underestimated. The models constructed are to contribute in no small measure to our air offensive and defensive programs.

It is doubtful if any greater privilege has been accorded to the schools of this Nation than that represented by this all-out war effort in the making of scale-model aircraft.

The construction of scale model aircraft differs in many ways from the building of flying models. Even the material is not the same. While balsa wood serves better than anything else for flying models, it is not suitable for models to be used by the military services for identification and other purposes. The scale-model builder may know little about aeronautics but should be able to read drawings, should know materials, and should be familiar with the use of tools.

It is hoped, however, that every one making scale models will not stop at that point but will build many flying models and become keenly interested in aviation. It will indeed be most disappointing if many hundreds of model airplane clubs are not formed as a result of this scale model activity.

The Air Youth Division of the National Aeronautic Association, Washington, D. C., and its affiliated local aero clubs, as well as the State aeronautics commissions will heartily cooperate in assisting groups to initiate and organize clubs.

GENERAL DETAILS OF THE PLAN

Because the models must be accurate and built to exact scale and require quality of workmanship there has been considerable thought given to plans and methods of procedure. Consequently, each individual and each group participating in the program will be supplied with complete information covering details and procedure. This booklet is part of the material to be given to each model maker to indicate general methods of constructing aircraft models. The large classroom chart may be appropriately mounted on cardboard, veneer, or other suitable material, or may be pasted directly on the wall. This chart indicates a series of steps desirable to be followed in making the models. In the center of the chart is a sketch showing nomenclature of different parts of a plane important in identification.

This booklet supplements the classroom chart and offers detailed instruction concerning each of the drawings on the chart. Actual plan material consists of two sheets for each model. (See Plan A and Template B which are considerably reduced and therefore not of correct scale. Page IV.) The first of these gives on the left three views of the specific airplane—top, front, and side. To the right is a perspective view with some parts unassembled. In addition, this first sheet includes some details concerning the plane model and a list of materials required to build the model.

The second sheet accompanying each plan consists of templates for each part.

PROCEDURE

Preparing Templates

A permanent set of templates for inspection purposes should be made first.

Cut out carefully with scissors all the template items on the template sheet. In cutting the templates none of the exterior lines should be eliminated, nor should any white paper be visible outside the template itself. Should it be desirable, these template sheets may be duplicated by "direct contact" blueprinting or photostating. To make the templates more permanent, the template might be fastened onto either sheet metal or cardboard, using rubber cement, shellac, or other adhesive which will not change the size of the drawing as ordinary paste or glue will do.

Caution: Suitable size envelopes or other receptacles should be provided to hold the templates as soon as they are cut out, otherwise important parts may be lost. Each template should be listed to avoid loss.

All work must be done exactly to plans. No minor details must be left off, nor must the imagination be used to add details other than those specified on the plans. All details to be included are in the plans. *Exactness is essential.*

Bill of Material

On each plan is given the details of the bill of material required for each model. This material may be white pine, ash, gum, poplar, or similar wood. It should be, of course, well-seasoned, straight grained, free from sap streaks, pith and knots. This is important as some of the parts are frail and would be easily damaged in ordinary handling if the wood were defective.

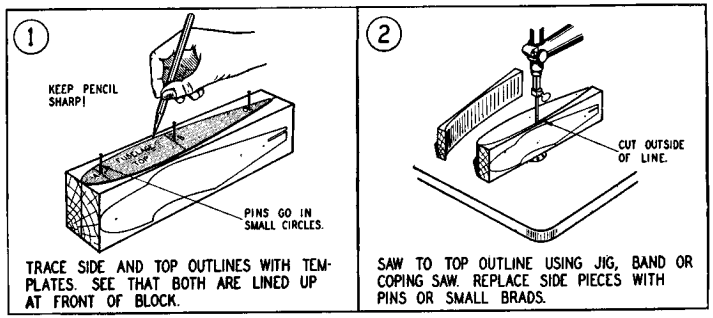
Under no circumstances must balsa be used. While it is light it is not suitable for scale model work for the military services and is needed in the emergency for other purposes. In some of the more fragile parts it is desirable to use maple or other hard wood. Tongue depressers or applicators, usually made of birch, obtainable from the drug store may serve in some places where harder wood is needed.

Before beginning actual construction of models, a word concerning lack of some details is in order. Only important identification details are called for in these models. This simplifies the model builder's task and eliminates delicate details which requires careful handling of the models. Details such as propellers, pitot tubes, aerials, navigation lights, guns, etc., do not materially lend to identification of planes.

FUSELAGE

Marking Out From Templates

Figure 1 shows how the fuselage may be marked out from templates. Mark a center line, as illustrated, around the entire block, if the model maker is to cut out the material with a scroll saw. The work will be more accurately done with a scroll saw if lines are followed on both



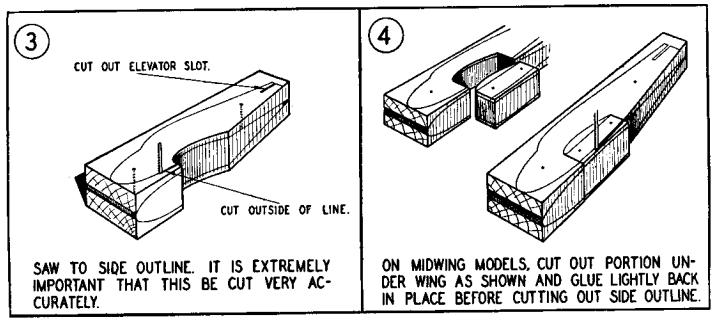
sides of the fuselage block. Such procedure is not necessary if the cut is to be done by a jig saw or band saw.

After marking off the fuselage "top view" template, the "side view" template can be used similarly to mark out the "side view" shape. The pencil should be sharp and held nearly upright. To prevent movement of the paper template it should be attached to the wood by pins placed in the small circles provided for this purpose.

Sawing Out the Fuselage Shape

Figure 2 needs no explanation except to say that the sawing must be carefully done in order to make the finished product exact to dimensions.

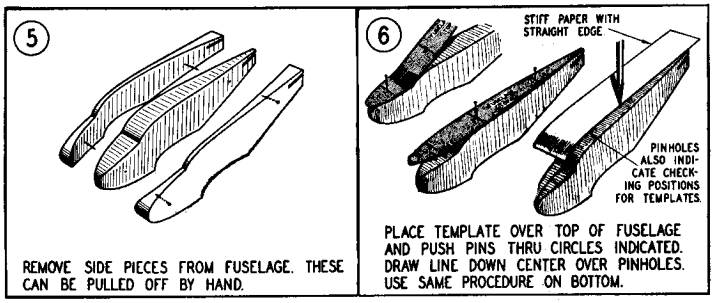
After the first cuts have been made giving shape to the fuselage as it



is viewed from above, the pieces of wood cut off should be fastened back in place either by drops of quick-drying cement or by very small nails or pins placed so as not to interfere with sawing. There will then be no difficulty in taking the second cut (Figs. 3 and 4). The final shape will then be as illustrated in Figure 5.

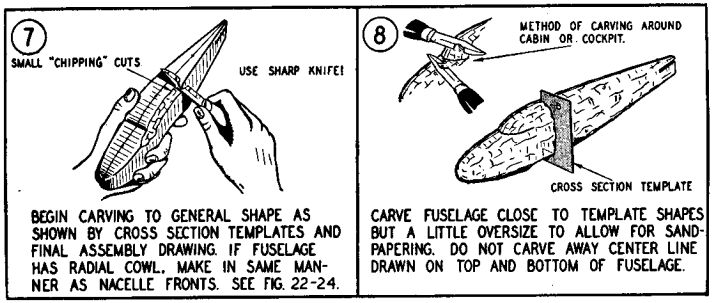
Locating Template Checking Stations and Drawing Center Lines

Figure 6 points out the suggested method for locating the stations for template checking and for indicating center line to simplify shaping the fuselage.



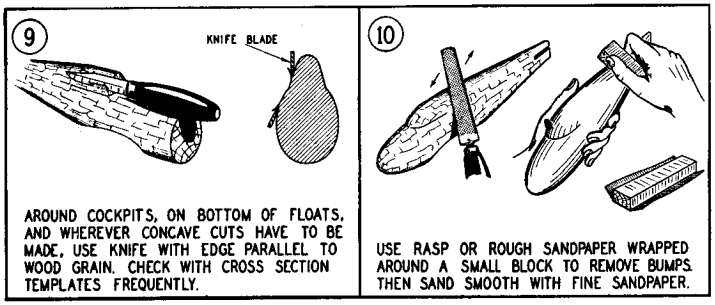
Cutting Fuselage Block to Shape

A certain part of the work of shaping the fuselage can be done by plane, spokeshave, fixed blade knife, wood rasps, or files (Figs. 7 to 10).



While shaping the fuselage it is essential that the templates provided be used frequently at the prescribed stations indicated on "fuselage top" and "side templates." An indication of procedure is shown in Figure 8.

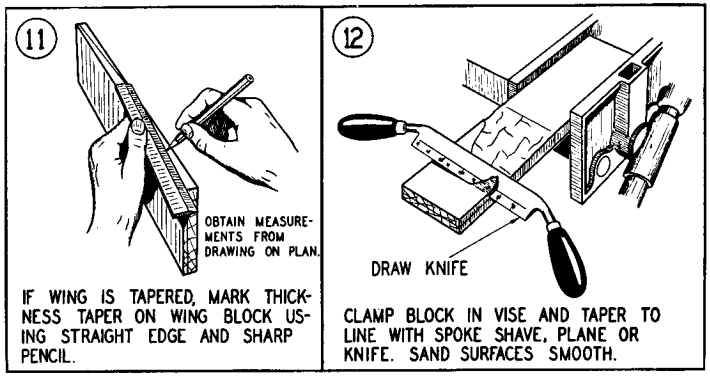
Keep the tools sharp for speed and quality of workmanship.



Those familiar with the making of scale models have found the securing of exact shapes simplified by using templates made of non-resilient material, such as "dead" annealed iron wire, lead solder, or aluminum wire. Such material can be bent around the block at the prescribed checking points and then used to check the shape on the opposite side or laid on the template sheet to check with the original outline.

Sanding the Fuselage

Where sanding machines are available sanding the fuselage may be simplified considerably. However, in machine sanding there is the danger of eliminating small details so essential to aircraft identification.

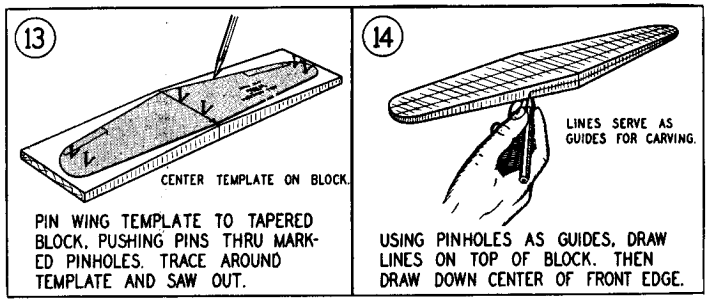


In sanding by hand various shapes of wood—round, square, and otherwise—should be used as backing for the sand paper. If the roughing-out process has been completed properly, sanding should not be a long job. In model making sandpaper from the grades 3/0 to 2 are suitable.

WINGS

Tapering the Wing

In accordance with the bill of materials, select the piece prepared for the wing and draw a center line at right angles to the grain. On the edges mark the taper indicated on the drawing and connect the lines across the end as shown (Fig. 11).

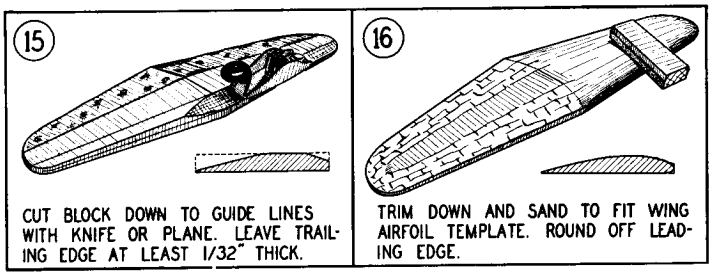


With a spokeshave, plane, or drawknife, taper the stock as shown (Fig. 12).

Cutting the Wing to Outline

Next, lay the wing template center line on the center line previously drawn on the stock. By pins or wire brads, hold the template in position and with a pencil held nearly upright, mark the outline on the stock (Fig. 13).

Be careful to use the small circles marked on the template for the position of the pins as these pin marks have another purpose. They are to be used for the drawing of lines showing limits for the tapering of the wing airfoil section as shown in Fig. 14. By band saw, jig saw, or coping saw cut the outline to the lines.



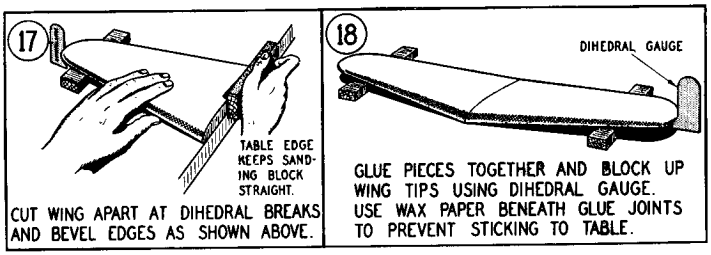
Shaping the Wing Airfoil

Figure 14 shows the wing ends rounded, and a center line being drawn on the edge of the wing for determining the cutting limits shown on the next drawing (Fig. 15).

Using the guide lines, as in Figure 15, the model maker can now by plane, spokeshave, rasp, file, or other means, bring the wing down to airfoil shape (Fig. 16) using the wing airfoil template. The rough shape should then be sanded to its finished form. Those familiar with actual wing shapes know their importance in determining the flight characteristics of the plane. It will be noted in some scale models that the lower side of the wing is practically flat.

Giving Dihedral to the Wing

When the wing has been finished to shape it is then sawed in half at the center line. The sawed ends of the wings should be sanded to provide for the dihedral indicated in the front view drawing of the three-view

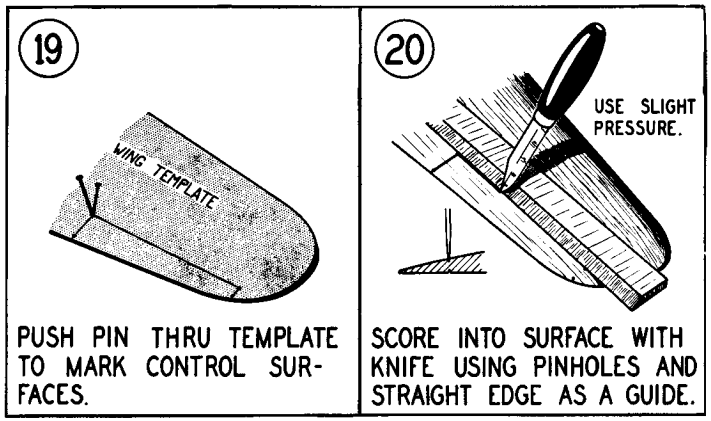


drawings in the plans. Use gauge as shown to insure proper bevel of wing base (Fig. 17). The ends should be carefully fitted for a glue joint. Figure 18 shows how the dihedral is to be checked by this gauge while wings are being glued together.

Use a good, strong, quick-drying glue. On larger models this joint should be strengthened by the use of dowel rod or other means. Ingenuity on the part of the model maker will indicate a method of doing this when necessary.

Marking the Ailerons

The wing template shows where the ailerons are located. Figures 19 and 20 point out how lines may be made on the wings to show the location of ailerons. Ailerons are to be marked on top and bottom surfaces of the wings.

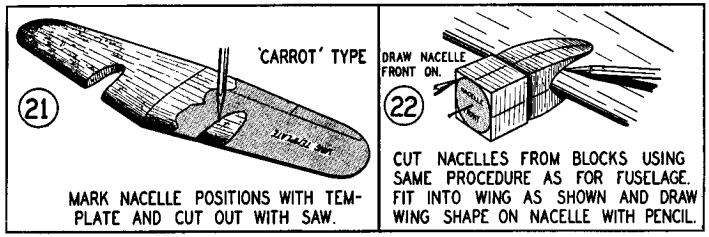


ENGINE NACELLES

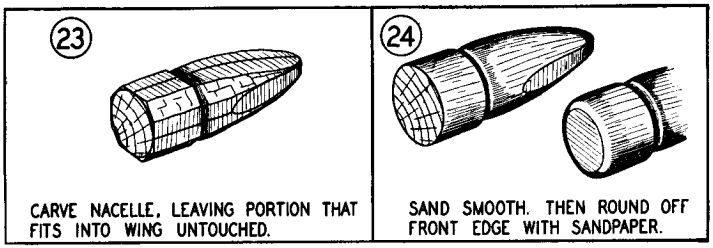
Fitting the Nacelles to the Wings

An aircraft nacelle is a streamlined enclosure which may be used to house an engine, fuel, pilots, passengers, or freight.

The making of engine nacelles may be the most difficult part of the building of model aircraft. Two methods of installing them are shown. The first is by fitting the nacelle into an opening cut into the wing, often called the "carrot" method (Figs. 21 and 23). The second is by making

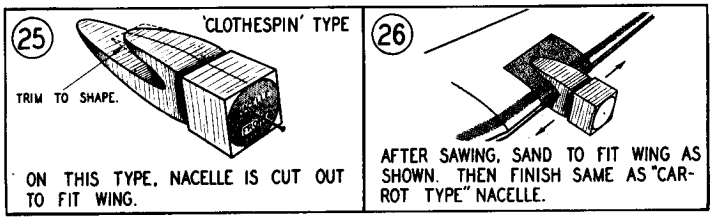


a "clothespin" type of opening in the nacelle itself and fitting it on to the leading edge of the wing (Fig. 25.). The model maker must keep in mind, in fitting the nacelle to the wing, that the nacelle must assume when finally glued in place the correct angle both horizontally and vertically. The sketches (Figs. 21 to 26) show how to proceed with the work.



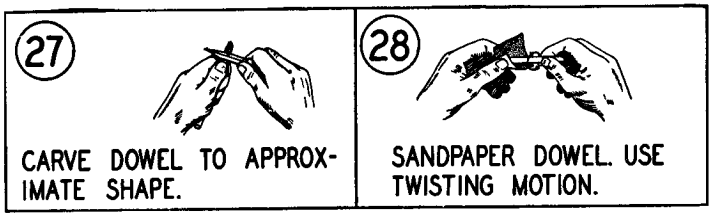
Making a Spinner

Figures 27 to 30 show how to make an engine spinner, which streamlines the propeller hub. In the illustration the spinner is shown made from a piece of dowel rod.



TAIL SURFACES

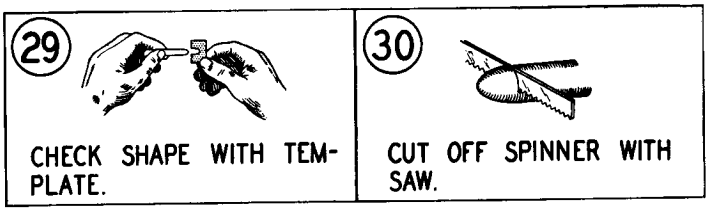
The same procedure can be followed in cutting out tail surfaces as that suggested for wings. In the scale model, of course, there are no hinges between stabilizer and elevator, or between fin and rudder, although hinges are to be indicated by lines marked on the finished work. Figures 31 to 34 show the procedure of building tail surfaces.



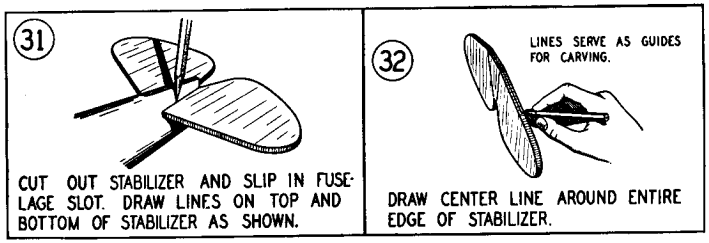
Streamlining

A center line should be drawn with a pencil around the edges to guide in making the streamlined shape (Fig. 32). Before cutting the elevator

to shape it should be placed in position in the slot in the fuselage and marked to indicate the limits for cutting the material as shown (Fig. 31). Figures 33 and 34 illustrate how the wood is to be cut and how sanding of this part of the plane may be carried out. In Figure 33 a section is shown to indicate the shape of the finished stabilizer and elevator. Similar procedure may be followed in preparing the fin and rudder.

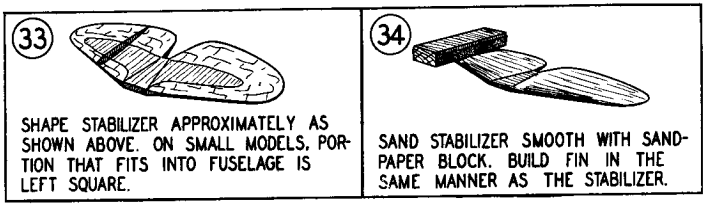


It may be desirable to use maple, birch, or other hard woods for the more fragile parts of the plane, such as fins, rudders, etc. It is not recommended, however, that other than the common woods suggested be used for the main parts of the models.



Other Details

Most of the models include details which can not be cataloged under wings, engines, fuselages, and tail surfaces. In flying models it is the custom to call the stabilizer and the elevator combined by the one term "elevator," because in the model there is no hinge and the two work as one. There may be "blisters," "knees" or other important identifica-



tion details which must be reproduced accurately in the models. It is essential that minor details be given careful attention as these are vitally important in identification.

ASSEMBLY

It is here emphasized again that *accuracy and quality of workmanship are essential* in the building of scale model aircraft. In final assembling of the parts fitting may be necessary.

Glueing Parts Together

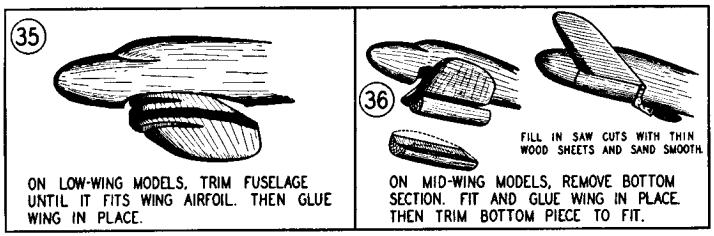
Care must naturally be exercised in assembling, as the glueing of a part in a wrong position will spoil the value of the model. In assembling a model it may be advisable to use cross-sectioned paper as a background. This is a simple way of insuring equal distances on parts which should balance one another in position and of insuring that parts which should be at right angles with one another are in correct position. A good, quick-drying glue should be used. Surfaces should be cleaned of all loose material before applying the glue. The type of glue provided in model airplane kits and supplied by manufacturers of model aircraft is preferable.

It may be advisable to construct a simple jig to hold the wing and other parts in correct position while the glue is drying. Much trouble will be avoided if the model builder is careful to see that the glue is dry on one joint before proceeding to the assembly of another.

Figures 17 and 18 show the preparation of a wing for glueing so that it may assume the right dihedral angle. It is possible to build some wings without cutting them in two. As has been stated before, it is necessary to strengthen the joints between the wings of some models by dowels or other material, such as pins, nails, etc. Care, of course, should be exercised to see that the fin, rudder, stabilizer and elevator are in proper alignment while the glueing is being done.

Fitting the Wings in Place

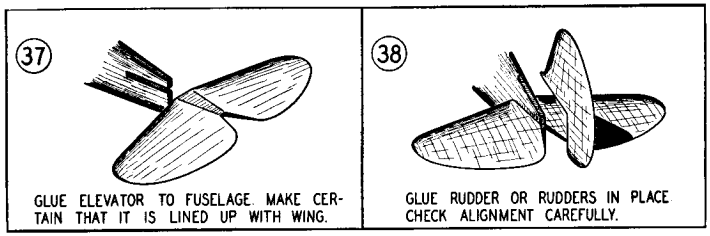
Figure 35 shows the assembling of wings on a low-wing monoplane, while Figure 36 points out how a wing is secured to a mid-wing monoplane.



Fairing a Wing

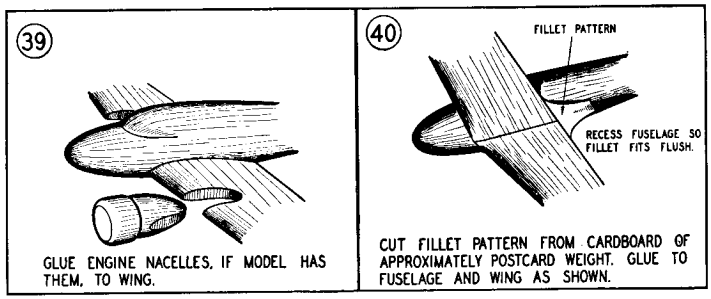
It may be necessary to provide a "fairing" or fillet to carry the wing line smoothly into the fuselage. This fairing in full sized airplanes has been found to increase the efficiency considerably. In the models this fillet or fairing material can be prepared from fine sawdust and glue made into a putty and fingered into place (Figs. 40-41). After it has dried it can be shaped and sandpapered to proper contour. It may be easier to put this putty on in several layers, allowing one layer to dry

before putting on another. Another method, perhaps a little more difficult, is to provide a strip of wood and glue it into position and finish it to correct shape. Figures 37 and 38 show tail assembly (empennage).



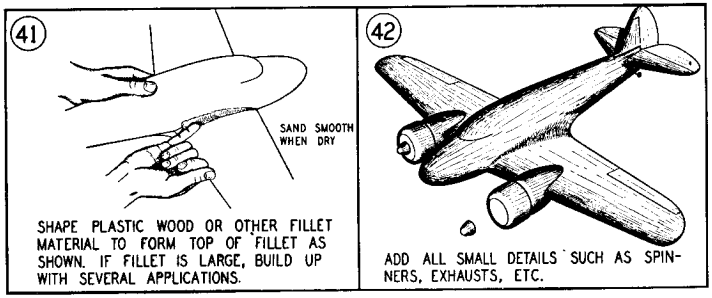
PAINTING

The military authorities prefer a black paint on these models because black does not allow for variation in appearance, because it reduces any

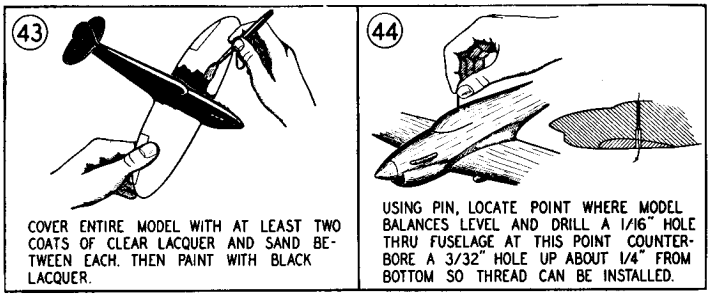


chance of interference with depth perception and affords the best study of the model in silhouette form. (Fig. 43).

The final finish should be a dull black. A shiny surface could cause



reflections which would distort the true outlines of the model. Before applying the paint, a coat or two of primer is recommended. For this purpose, banana oil or clear lacquer are ideal. The lacquer with a cellu-



lose base and dye for color may be used to speed up drying time. If a slow drying paint is used be sure the proper primer is used to avoid "lifting". It should be of good quality, free from lumps or foreign material and applied in thin coats. Model aircraft dope is suitable. Each coat is allowed to dry properly and lightly sandpapered with 3/0 or finer sandpaper before applying the next coat. The final coat of paint should be finished with very fine sandpaper (7/0 is ideal). Rubbing compound or pumice stone and linseed oil is good for rubbing down surface. This is necessary to prevent any gloss and to produce the preferred finish.

Where equipment is available, spray painting may produce a better job than brush painting although the latter is quite satisfactory.

SUSPENSION OR MOUNTING OF MODELS

The completed models are to be used in many ways. Many of them will be suspended, hence the center of balance must be determined. The true point of balance may be determined by sticking a pin into the upper fuselage surface in different positions until the right point is found (Fig. 44). At this point drill a $\frac{1}{16}$" diameter hole through to the under side. A larger hole, then, possibly $\frac{3}{32}$", should be drilled up part way to form a recess for the knot of a suspension cord. This operation should be done after painting is finished; otherwise center of balance will not be correct.

LABELING

In order that the labeling may be uniform it is suggested that a piece of medical adhesive tape, size ½"x1", be marked in indelible pencil with the abbreviated designation of the particular model, such as SBD-3, PBY-5, etc. and affixed in the center of the under side of the left wing looking forward.

In local exhibitions it may be desirable to attach a small tag by means of a string to the model and put on this tag such information as the symbol, official name, and type. Arrangement will be made locally for inspection of the models and the awarding of certificates to those who have done satisfactory work on the project.

For inspection purposes, the model should be identified by a special assigned number and not by name of the builder. After inspection, a piece of adhesive tape similar to that previously referred to may be used for official name of the plane, its type and nationality, the name of the

individual constructing the model, the school he represents, and its location. This label should be attached to the under side of the right wing looking forward.

LOCAL DISPLAY OF MODELS

A display of sets of models before packing and shipping will be both educational and impressive.

The local aero club will no doubt be able to render considerable aid in securing stores, libraries, public buildings, and other suitable places in towns and cities. Schools can display them in classrooms, libraries, shops, gymnasiums, and other suitable places. These displays should be announced in newspapers and elsewhere to draw attention to the importance of aviation in present day affairs.

CERTIFICATES OF AWARD

The certificates of award to be given by the U. S. Navy Bureau of Aeronautics will be presented by local school authorities to those who make models which pass the final inspection.

Certificates may be awarded from time to time or at the close of the school year. The certificates may be supplemented by local awards, prizes, scholarships or other means of recognition made possible by interested individuals, clubs, and other agencies.

PACKING OF SCALE MODELS

Many suggestions may be made as to the variety of methods of packing scale models. However, those who have had extensive experience in packing models, suggest that the model be suspended in resilient material, such as excelsior lightly packed or loose crumbled newspaper. The carton in which the model is individually packed should be large enough to prevent the model from touching the sides. Individual packaged models, however, are to be packed in larger containers in groups.

Each box should contain ten models having serial numbers in sequence. For instance, planes with serial numbers A-1 to A-10 should be in one box and planes with serial numbers A-11 to A-20 in another. Serial numbers appear in title boxes of plan and template sheets.

All models must be properly inspected before packing and the package must contain an inspection slip signed by the individual responsible in the local community where the models were made.

SHIPPING

Shipping instructions are not included here. They are available only to those authorized locally to send the models to their designated destinations. Five hundred thousand models shipped without proper authority obviously would result in confusion.

Do not ship models other than through recognized channels, arranged by local school systems.

Do not write to the U. S. Navy or the U. S. Office of Education, as both these agencies are fully engaged in war effort. Local directors can supply all the information necessary.

CHAPTER II

IDENTIFICATION OF AIRCRAFT

This booklet would be incomplete without some discussion of the principles of aircraft recognition. With some of these principles in mind

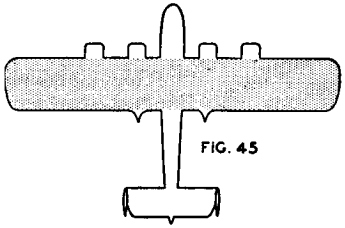


FIG. 45

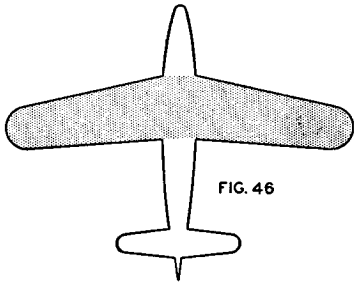


FIG. 46

those who build scale model aircraft will realize the importance of accuracy and attention to details in actual construction and will get firmly in mind the features to be remembered in connection with the models

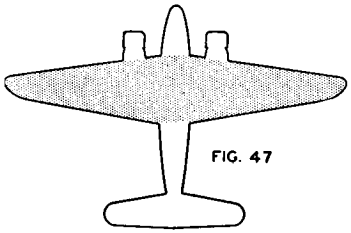


FIG. 47

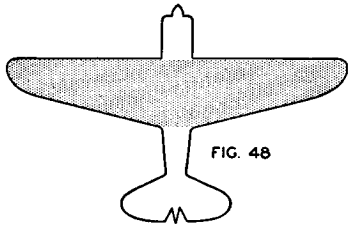


FIG. 48

being made. As a consequence, the practice of identifying aircraft will become easier.

In identification of aircraft the word WEFTO may form a basis for identification, "W" standing for Wing, "E" referring to Engines, "F"

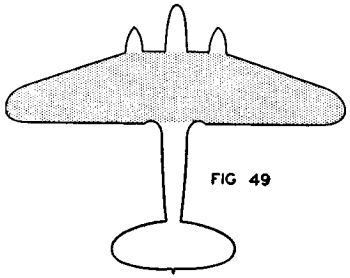


FIG 49

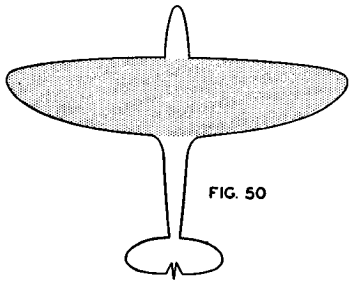


FIG. 50

to cover the Fusclage, "T" to refer to Tail Surfaces, and "O" to include Other items. The discussion of this subject will, therefore, start with the wings.

Wings

Wings may be classified under several general heads which can also include such biplanes as may at prescnt be used for training and other purposes. Figures 45 to 50, inclusive, illustrate outstanding types: Figure 45, parallel wings; Figure 46, wings swept back; Figure 47, taper; Figure 48, taper swept forward; Figure 49, taper swept backwards; and Figure 50, elliptical.

The position of the wings in relationship to the fuselage is significant. The connecting points of the wings with the fuselage give the general classification of low-wing type (Fig. 51), mid-wing type (Fig. 52) and high-wing type (Fig. 53).

FIG. 51

FIG 52

FIG. 53

FIG 54

FIG.55

FIG 56

FIG 57

There must also be taken into account the head-on view shapes of the wings as a means of recognition. These may be catalogued as follows: horizontal (Fig. 54), dihedral (Fig. 55), gull wing (Fig. 56), inverted gull wing (Fig. 57).

Engines

The number of engines classifies a plane definitely. A 3-engine plane, for instance, would be Italian, as no other nations use them at present. It is important to know whether the engines are in-line or radial. Engine locations, of course, are significant.

Fuselage

Some fuselages are short and stubby (Fig. 58) while others are long and thin (Fig. 59). Some range between these two extremes (Fig. 60).

FIG. 58

FIG. 59

FIG. 60

The recognition of the characteristics of a fuselage is important and essential to identification.

Tail Surfaces

The tail surfaces are significant and it is important that the outline shapes be kept in mind as a basis of recognition.

In general, there are two types of tail surfaces: The single (Fig. 61)

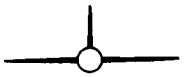


FIG. 61

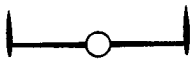


FIG. 62

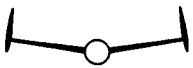


FIG. 63

consisting of fin, rudder, stabilizer, and elevator, and the twin type tail surface (Fig. 62) connected horizontally or with dihedral angle connection (Fig. 63). Both the horizontal and dihedral types have double fins and rudders.

Other Items for Identification

It would be difficult, if not impossible, to list all items for identification outside of those which may be classified under wings, engines, fuselage, and tail surfaces. For instance, on one outstanding airplane, the radiators for cooling the oil and engine coolant protrude significantly beneath the plane. One glimpse of these two radiators immediately classifies the aircraft. The shape and location of the cockpit may often be a distinguishing feature of an aircraft.

It should not be difficult for an individual interested in spotting aircraft to pick out the *most significant features* as a basis for determination of the aircraft as a friend or foe.

CHAPTER III

INSPECTION OF MODEL AIRCRAFT

In model aircraft used for military purposes it is essential that planes be made to exact scale dimensions and that *all identifying features be included.*

To insure the correctness of the models requested by the military services, each model must be carefully inspected previous to shipment. It is not intended by the Navy to open the boxes previous to re-shipment to final destination. Because of this it is planned to have each model inspected before packing by selected individuals or a committte and the final inspection form signed by the person responsible.

Inspection Committee

Because of the desirability of enlisting the cooperation of as many persons as possible it is recommended that a final inspection committee be formulated from those acquainted with high grade skills. It should be possible to secure the services of skilled craftsmen, such as tool makers, pattern makers, cabinet makers, expert aeromodelers, and others having suitable skills. *The local chapters of the National Aeronautic Association, Civil Aeronautics Administration personnel, and State Aeronautics Commissions* can render most valuable assistance in inspection and other matters.

Templates for Inspection

If any considerable number of planes are to be checked from the same templates it would be advisable to provide templates of more permanent type than those supplied in paper form. Local facilities will indicate a solution to this problem. It has been suggested that instructors and others make a few models for the sake of determining the best procedure. The matter of desirable means of inspection can be determined during this preliminary study.

Minor Items

The model maker may consider as unimportant certain details of fuselage, wing, engine, or tail surfaces. The pilot and the gunner, however, may recognize the plane as either friend or foe by some such seemingly insignificant feature. The inspection, therefore, must place special emphasis on *exact conformity to plans.* Nothing, not even a propeller, must be added.

Identifying Modelers for Awards

So that there may be no possibility of favoritism it is suggested that planes, while being inspected, be identified by a number only. At the conclusion of inspection, when those qualified for certificates have been designated, approved planes should be fully identified, including the name of the school and the name of the individual builder.

Awards

All certificate awards are to be based on recommendation of the final inspection committee.

Filling Out the Form

The form for inspection which is to be checked in the appropriate spaces and signed by the persons responsible covers wings, engines, fuse-

lages, tail surface, and other items. The word WEFTO from the sequence in which inspection takes place indicates procedure which may be followed in identifying aircraft. The British are using words like this in various ways to insure covering all items.

WINGS

Span—This should be checked to show that the wing from tip to tip meets specifications.

Outline—The outline referred to is the one seen when looking from above at the wing shape. This is important because wings vary in shape, some being parallel, some are tapered, some have unusual shapes, etc.

Dihedral—The dihedral angle is important in identification because it is easily observed and is a definite distinguishing feature.

Tip Shape—Wings vary considerably at the tips. Therefore, this feature should be given careful consideration.

Ailerons and Flaps—Although ailerons and flaps are not noticeable from the distance they should be checked for correctness both on the upper and lower sides of the wings.

ENGINES

Location—The engines, if more than one, should be placed on the wings in the location specified. Distances should be checked carefully.

Distance from Leading Edge—Difficulty may be encountered in installing the engine nacelle on a model wing. The model maker will need to be accurate in his workmanship or the model may be of little value. It should be checked to see that the engine protrudes from the leading edge of the plane the distance specified by the templates.

Nacelle Shape—The shape of the nacelle, especially the streamlined shape at the wing itself is important and should be according to the plans.

FUSELAGE

Contour Shapes—In planes where the wings are located in such a position as to make it difficult to use the templates in their original form it may be necessary to provide templates with sections cut out so that they can be placed directly on the fuselage. The fuselage is vitally important in identifying aircraft. Special significance applies to what may seem minor items. A model maker may spoil the possibility of correct identification of an aircraft if he modifies even to a small extent the pilot's cockpit or the machine gunner's turret. The inspector, therefore, should be careful to see that the horizontal and vertical sections of the model comply with the templates.

Shapes at Stations—In the templates certain shapes are provided for various stations on the fuselage. These shapes must be checked on both sides to insure accuracy.

Projections—Projections on the fuselage may identify it as belonging to a specific aircraft.

TAIL

Tail surfaces are discussed for inspection purposes in one paragraph. All tail surfaces have specific shapes easily recognizable. Some tail surfaces are dual.

OTHER ITEMS

There are certain features on some planes, such as floats, wing tip floats and special features not perhaps altogether common. These should be checked carefully to see that they comply with specifications in the plans.

ACCURACY IN ALL DETAILS IS ESSENTIAL

The inspection form should be signed by the Chairman of the Inspection Committee or other responsible individual and should be enclosed with the models.

★ ★ ★

CHAPTER IV

AVIATION BIBLIOGRAPHY

Because of the interest which has developed in the study of aviation during the past few years, there is a great deal of published material on the subject. The Library of the U. S. Office of Education compiled a list of recent material on the subject which includes books and periodicals.

This list has been reviewed by the National Aeronautic Association. It is hoped that this list will serve for those who wish to purchase current material on the subject.

BOOKS

AIR YOUTH DIVISION, NATIONAL AERONAUTIC ASSOCIATION. Building and flying model airplanes; an Air Youth handbook. New York, Appleton-Century, 1941. 246 p. illus. $2.00

AIR YOUTH DIVISION, NATIONAL AERONAUTIC ASSOCIATION. Model airplane contests; an Air Youth guide with official rules. New York, Appleton-Century, 1940. 106 p. $1.25

AIR YOUTH DIVISION, NATIONAL AERONAUTIC ASSOCIATION. Youth in aviation; an Air Youth manual for leaders. New York, Appleton-Century, 1941. 265 p. illus. (Bibliography; p. 245-250) $2.50.

ARNOLD, MAJ. GEN. H. H. and EAKER, LIEUT. COL. IRA C. This flying game. New York, Funk & Wagnalls, 1938. $3.00

CRUICKSHANKS, J. W. B. Air foil sections for the aeromodeller. London, H. Marshall & Son, 1940. 46 p. illus. 1s 6d

ELWELL, J. H. Solid scale model aircraft. London, H. Marshall & Son, 1940. 88 p. 3s

GRAHAM, E. P. and CLEVELAND, R. M., editors, Model plane annual, 1941-1942. New York, R. M. McBride & Company, 1941. 248 p. illus. $2.00

GRANT, CHARLES HAMPSON. Model airplane design and theory of flight. New York, Jay Publishing Corp., 1941. 512 p. $3.75

JOHNSTON, S. PAUL. Horizons unlimited. New York; Duell, Sloan and Pearce, Inc., 1941. $3.75

JORDANOFF, ASSEN. Safety in flight. New York, Funk & Wagnalls, 1941. $3.00

JORDANOFF, ASSEN. Through the Overcast. New York, Funk & Wagnalls, 1937. $2.50

JORDANOFF, ASSEN. Your wings. New York, Funk & Wagnalls, 1940. $2.50
MC DOUGALL, HARRY. Flying model planes. Toronto, I. L. Hobden (Canadian agent for religious tract society, London) 1941. 160 p. 6s
OTT, LESTER. Aircraft Spotter. New York, Harcourt, Brace. $1.00
RUSHBROOKE, C. S. ABC of model aircraft construction. London, H. Marshall & Son, 1940. 104 p. 2s 6d
RUSSELL, D. A. Design and construction of flying model aircraft. 2d edition enlarged. London, H. Marshall & Son, 1940. 255 p. 6s 6d
SPAREY, L. H., and RIPPON, C. A. Models for flying. Toronto, Wm. Dawson Service (Canadian agent for Percival Marshall & Co., Ltd., London) 1940. 179 p. 174 illus. 3s 6d
STUBBS, S. B. Design of Wakefield models. London, H. Marshall and Son, 1940. 46 p. 1s 3d
TOWNER, H. J., and BOYS, H. Scale model aircraft that fly. London, H. Marshall & Son, 1940. 107 p. 3s
U. S. DEPARTMENT OF COMMERCE, CIVIL AERONAUTICS ADMINISTRATION. Training and employment opportunities in aviation. Washington, D. C. 15 p. Free
U. S. OFFICE OF EDUCATION. Airline hostesses. Washington, D. C. 1940. 11 p. (Misc. 2202) Free
U. S. OFFICE OF EDUCATION. Aeronautics courses in colleges and universities. Washington, D. C. 1940. 6 p. (Misc. 2177) Free
U. S. OFFICE OF EDUCATION. Aviation courses, federally aided. Washington, D C. 1941. 41 p. (Misc. 2295) Free
U. S. OFFICE OF EDUCATION. Aviation for youth. Washington, D. C. 1941. 9 p. mimeog. (Misc. 2925) Free
U S. OFFICE OF EDUCATION. Aviation in the public schools. Washington, D. C., United States Government Printing Office. 1936. 78 p. 15c. (Vocational Education Bulletin No. 185)
U. S. OFFICE OF EDUCATION. Aviation periodicals for class and club use. Washington, D. C. 1940. 4 p. (Misc. 2179) Free
U. S. OFFICE OF EDUCATION. Aviation training for women. Washington, D. C. 1941. 11 p. mimeog. (Misc. 2594) Free
U. S. OFFICE OF EDUCATION. Education and aviation. Washington, D. C. 1940. 15 p. mimeog. Free
WINTER, WILLIAM. The model aircraft handbook. New York, Thomas Y. Crowell. 1942. $2.00
YATES, RAYMOND F. Model gasoline engines. New York, Appleton-Century, 1941. $2.50

PERIODICALS

AERO DIGEST. Aeronautical Digest Publishing Corp., 515 Madison Avenue, New York, N. Y. Monthly. Yearly subscription $3.00
AIR TRAILS. Street & Smith Publications, 79 Seventh Avenue, New York, N. Y. Monthly. Yearly subscription $1.50
AMERICAN AVIATION MAGAZINE. American Aviation Associates, Inc., Washington, D. C., Earle Building. Semi-Monthly. Yearly subscription $3.00
AVIATION. McGraw-Hill Publishing Co., 330 W. 42nd Street, New York, N. Y. Monthly. Yearly subscription $3.00
CIVIL AERONAUTICS JOURNAL. United States Civil Aeronautics Authority, Washington, D. C. Semi-Monthly. Yearly subscription $1.00. Superintendent of Documents, United States Government Printing Office, Washington, D. C. Single copies 5 cents
MODEL AIRPLANE NEWS. Jay Publishing Corp., 551 5th Avenue, New York, N. Y. Monthly. Yearly subscription $1.65
NATIONAL AERONAUTICS. National Aeronautic Association of United States of America, Inc., 718 Jackson Place, Washington, D. C. Monthly. Yearly subscription $3.00
PILOT. Pilot Publishing Co., Glendale, Calif. Monthly. Yearly subscription $1.00
FLYING AND POPULAR AVIATION. Ziff-Davis Publishing Co., 550 No. Michigan Ave., Chicago, Ill. Monthly. Yearly subscription $3.00
SOUTHERN FLIGHT. Southwestern Aviation Publishing Co., Ledger Building, Fort Worth, Texas. Monthly. Yearly subscription $2.00
U. S. AIR SERVICES. Air Service Publishing Co., 227 Transportation Building, Washington, D. C. Monthly. Yearly subscription $3.00
WESTERN FLYING. Occidental Publishing Co., 304 S. Broadway, Los Angeles, Calif. Monthly. Yearly subscription $2.00