All about MODEL AIRCRAFT

by P.G.F. Chinn

MAKING A START • RADIO CONTROL IN A NUTSHELL
BUILDING AND FLYING A CONTROL LINE TRAINER
YOUR FIRST ENGINE • FUELS & HOW TO MAKE THEM

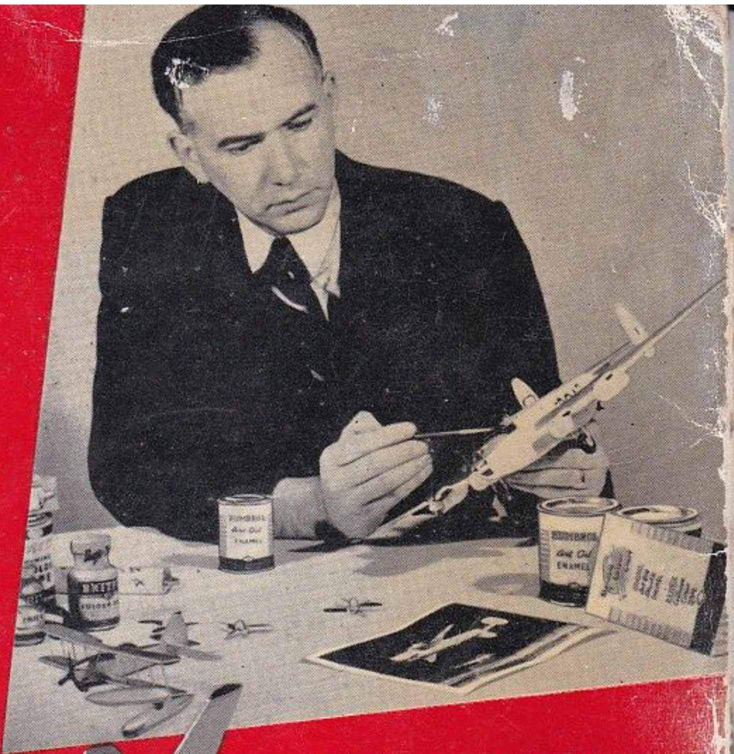
OVER 350 HOW-TO-DO-IT PHOTOGRAPHS

6/-

A MODEL AIRCRAFT HANDBOOK

Leading model makers use HOC HUMBROL BRITFIX products

One of the world's finest collection of models is that owned by Mr. Peter Farrar. Mr. Farrar always uses HOC products for durability and perfection of finish.



The Humber Oil Company's range of modelling products has been rigorously tested and proven by model makers everywhere. Constant laboratory checks ensure that only the finest products leave the factory to bring you better modelling.

HUMBROL PAINTING KIT
The all-in-one painting kit, containing plastic enamel, metallic colours and thinners, a paint brush, mixing palettes, tube of flatting agent for producing matt finishes, and colour blending chart; 8/11.

BRITFIX PLASTIC POLYSTYRENE CEMENT
This entirely new Plastic Polystyrene Cement has been produced to meet the demand for a high quality plastic adhesive. It combines quick drying with excellent adhesive properties, and does not string
Tube **6d.**

BRITFIX CEMENT
All purpose adhesive, heat proof, quick-drying, transparent water proof, suitable for balsa, soft and hard woods, plastics, leather, etc.
Tubes from **7d.**

BRITFIX COLOUR DOPES
Clean and bright, smooth and easy to work with. Quick drying, they provide the perfect finish which all good craftsmen expect. Available in clear and a wide range of colours.
Jars from **8d.**

HUMBROL ART OIL ENAMEL
A 4-hour lacquer enamel which dries with a brilliant finish; ideal for all decorative and finishing purposes. Authentic matt colours are also available for realistic finishes to model aircraft.
Tins from **8d.**

The Humber Oil Company Ltd. · MARFLEET · HULL

BUILD and FLY these famous
KEILKRAFT
models
ALL 3/9 EACH
RUBBER POWERED F/S SERIES
20" Span HURRICANE
18" Span SPITFIRE
Kits contain full-size plan, building and flying instructions, plastic propeller, plastic wheels and nose plug, cement and ample building materials
Auster Arrow 21" span
Piper Family Cruiser 21" Span
Percival Provost 19" span
D.H. Chipmunk 20" span
Stinson Flying Station Wagon 19" span
Fairey Junior 18" span
Erco Ercoupe 20" span
Fairey Gannet 20" span
Fokker D-8 16" span
Piper Super Cruiser 18" span
Globe Swift 20" span
Cessna 19½" span
ALSO
16" Sopwith Camel
17" M.E.109
18" Lysander
16" S.E.5
16" Nieuport
20½" Bonanza
18½" Mustang
18" F.W.190
Stuka (Price 4/1)
JETEX 50 POWERED SERIES
13½" Venom
15" MiG-15
14" Supermarine Swift
15" N.A. Sabre
13½" Attacker
17" Panther
13½" Hunter
KEILKRAFT JAVELIN
NOT ILLUSTRATED—13½" Skyray, 14" Avro 707A, 14" Fiat G.80, 19½" D.H. Sea Witch (price 4/2).
Kits contain bubble canopy, cement, tissue, ample balsa strip and sheet, full size plan, building and flying instructions.
3/9 EACH
SUPER-SCALE MODELS
For engines .3-.87c.c.
KEILKRAFT LUSCOMBE SILVAIRE
The three finest scale kits that money can buy! Ask your dealer.
Special design features include—
Plastic cowl
Crashproof one piece wings
Completely cowled, side mounted engines.
Detachable flying surfaces.
Detailed instructions for rubber power.
40" LUSCOMBE SILVAIRE
40" PIPER SUPER CRUISER
36" CESSNA 170
22/- EACH
KEILKRAFT
THE GREATEST NAME IN MODEL KITS
E. KEIL & CO. LTD., WICKFORD, ESSEX

ED
TRADE MARK

Radio Controls

Equipment which will enable the user to operate, independently, more than one control, is now demanded by most enthusiasts.

The reliability and ease of control of the Tuned Reed System, pioneered by E.D., has, after long and exhaustive experiment and tests, been amply demonstrated and proved by continual successes in open competition.

E.D. now produce six models, which will adequately meet the demands of most enthusiasts. Three of these are illustrated and the others are:—

The " BOOMERANG "
A Hard Valve Receiving Set, completely wired and ready for use. Includes, Transmitter Receiver Escapement. Range approx. 500 yd. Price complete, **£11 18s. 6d.**

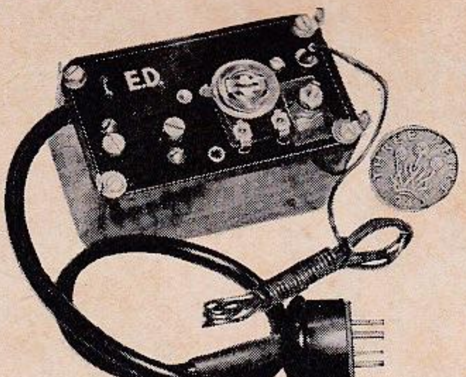
E.D. Mk. IV RADIO CONTROL UNIT
Tuned Reed—3 channels, for the multiple control of all models. Price complete, **£20 9s. 7d.**

P.C.I TRANSMITTER
A high powered, super compact, lightweight portable Radio Control Transmitter. Price (less batteries), **£5 19s. 9d.**

Ask for, and insist on, E.D.

the finest Equipment for the Model Maker

A comprehensive range of Radio Controls, Mechanisms, Spare Parts, Accessories, is also available. Full details are given in our illustrated lists—free on request.



H.T. Supply—22½ volt battery.
Idling current—0.6 ma.
Current Change—0.6 ma.
L.T. consumption—25 ma.
Hard Valve—no quench coils.

The " AIRTROL "
HARD VALVE RECEIVER

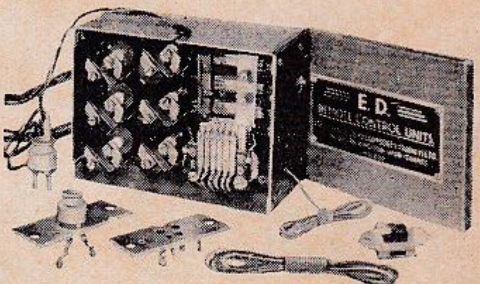
The smallest Receiver in the World . . . .

Size 2½ in. x 1½ in. x 1½ in. and weighs only 2½ oz. The latest addition to the E.D. range of Remote Control Receivers, specially developed to meet the great demand for a transistor hard valve receiver with a specification producing the ultimate in Radio Control.

Simple tuning.
Two transistors for output and economy.
Valve life—4,000 hours.
Price **£7 5s. 0d.**

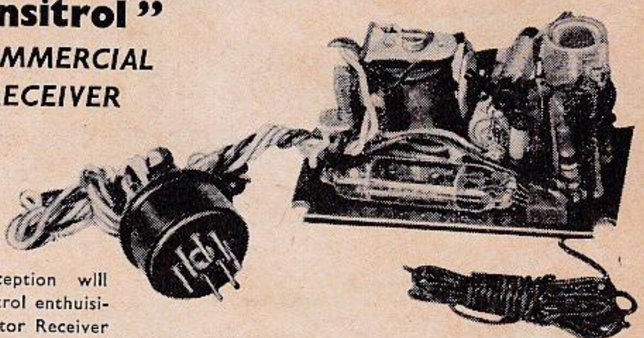
The Mk. V " EVEREST "
TUNED REED 6 CHANNELS

MULTIPLE RADIO CONTROL UNIT. Includes CONTROL BOX, size 6 in. x 5½ in. x 2½ in. giving up to six controls.



TRANSMITTER and RECEIVER with 9 ft. Sectional Aerial. Fitted with Standard Hard Valves and six standard relays. Price complete **£29 3s. 11d.** (sold separately).

The " Transitrol "
THE FIRST COMMERCIAL TRANSISTOR RECEIVER



E.D., of course, were again first to introduce this new technique. Its advantages in size, weight, current capacity and quality in reception will appeal to all Radio Control enthuisilasts. This valve transistor Receiver combines all the advantages of multi-valve modulated Receivers together with simplicity and very low Receiver Battery size and weight.

RECEIVER. Size 2½ in. x 1½ in. x 1½ in. Weight 2½ oz.
Price—Receiver, Transmitter and Escapement, **£12 15s. 6d.**

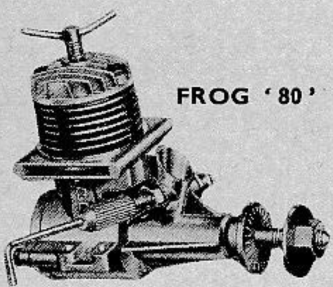
All prices include P. Tax.

E.D. ELECTRONIC DEVELOPMENTS (SURREY) LTD
DEVELOPMENT ENGINEERS
PHONE: MOLESEY 6037-6038 ISLAND FARM RD. WEST MOLESEY. (SURREY) ENGLAND. GRAMS. "EEDEE" EAST MOLESEY


VERON
more popular every month!
Introducing
The 'DEACON'
Emphasis in the design is for straightforward construction by either "embryo" or "contest" Aeromodellist.
THE CARDINAL'S BIG BROTHER!
This superb new "Veron" kit s designed as a larger multi-purpose development of the supremely successful "CARDINAL." With a span of 52 in. and 410 sq. in. of area it can be powered with 1 to 1.49 c.c. motors for Sport Free Flight, I c. . "PAA-load" or for simple single-channel Radio Control for rudder operation only.
Kit includes: Super-graded and prepared strip and sheet parts, die-cut ribs, printed formers, etc., "Sorbo" Wheels, and "Modelspan" covering 30 x 40 in. plan with fully detailed instruction brochure.
A perfectly proportioned modernistic performer
KIT PRICE
(including P.Tax)
34/6
The Famous 'TRU-FLITE' Flying Scale Models
★ A RANGE OF 22 KITS NOW AVAILABLE ★
All "VERON" TRU-FLITES have extremely simple construction and are ideally suited to the newcomer to modelling.
Kits include" "Easy-to-follow" fully illustrated plan and instructions, plastic propeller, wheels and nose bush, ready-formed propshaft and selected materials.
WONDERFUL VALUE at only 3/7 each (Tax paid)
ME. 109G. (18 in. span). Germany's equivalent to the "Spitfire"—but never its master!
S.E. 5A. (15 in. span). World renowned 1916-18 Fighter—Loved by all who flew it.
WILDCAT (20in. span). American Grumman Shipboard fighter used widely by the Pacific fleet and British Royal Navy.
F.W.190 A.3. (18 in. span). Germany's outstanding fighter during 1940-44.
WILDCAT
ME.109G.
S.E.5A.
F.W.190 A3.
ASK YOUR DEALER FOR FULLY ILLUSTRATED FREE "VERON" POCKET FOLDER
VERON
THE MOST POPULAR KITS IN THE WORLD
MODEL AIRCRAFT (Bournemouth) LTD.
NORWOOD PLACE · BOURNEMOUTH · HANTS
Telephone: SOUTHBOURNE 43061 · WHOLESALE ONLY

FROG MODEL ENGINES

they're so reliable!



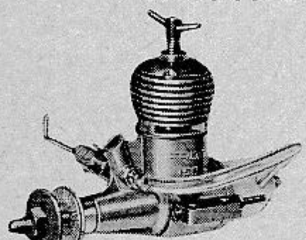
FROG '80'

Especially suitable for F/F scale models. Exhaust stacks for cowled instsllation, Vibration-proof self-locking compression screw. High duty silicone rubber contra-piston seal. Ratchet needle-valve lock. Weight 1.9 oz. B.H.P. 0.065 at 12,000 R.P.M.

Price **47/6** *inc. tax*

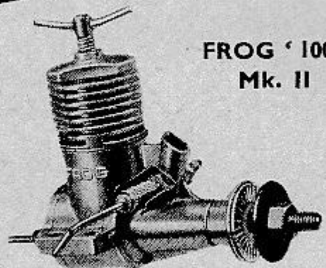
Self-contained nylon tank available as extra. *Price* **3/6**

FROG '150' Mk. II TYPE 'R'



A really "hot" contest engine at a low price. The "150" Mk. II Type "R" has a performance equal to any ball-bearing engine in production. Especially suitable for ½A team-racing and power-duration models. Using a Frog 7 in. x 4 in. nylon airscrew 72 to 77 m.p.h. can be easily obtained in a team-racer. High power-weight ratio. Easy starting. Moderate fuel consumption. Also available in water-cooled form for marine installations. "Vandervell" main bearing. Ratchet needle-valve lock. Weight (with nylon tank) 3.1 oz. B.H.P. 0.15 at 14,500 R.P.M.

Price **55/-** *inc. tax*

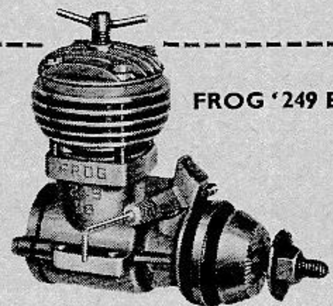


FROG '100' Mk. II

The ideal beginner's engine. Sturdy construction to withstand mishandling by the novice. Supplied complete with Airscrew and nylon fuel tank ready to run. Also available in "bare" form for the expert in whose hands it is a potential contest winner. Exceptionally easy starting. Ratchet Needle-valve lock. Distinctive gold anodized cylinder. "Vandervell" main bearing. Weight (with fuel tank) 3 oz. B.H.P. 0.104 at 15,000 R.P.M.

Price **65/4** *inc. tax*

(55/- BARE *inc. tax*)



FROG '249 BB'

A powerful contest-type engine, completely free from temperament. Its smooth running qualities make it very suitable for medium-size R/C models. Twin ball-bearing crankshaft for smooth running and high power. Angled needle-valve for safe operation. Ratchet needle-valve lock. Synthetic rubber seal to protect outer ball-race. Weight 6 oz. B.H.P. 0.265 at 15,000 R.P.M. *Price* **79/3** *inc. tax*

FROG '249 B.B.' MODIFIED

This is a special "super" performance version of the "249" embodying a different cylinder liner and modified timing. Even higher output with no loss of easy starting qualities. The cooling fins are anodized red to distinguish it from the standard "249"

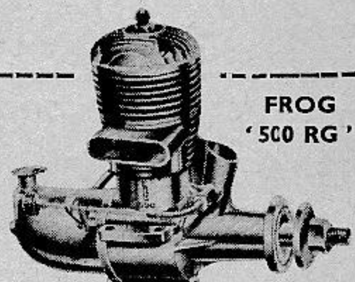
Price **94/9** *inc. tax*

FROG '149'

The ideal "Sport Flying" Engine. Very flexible running over a wide speed range (4,000-15,000) under load. Very suitable for small R/C Models.

Exclu.ive Frog "Vibra-matic" inlet valve giving great flexibility and low fuel consumption. Will run in either direction. (Very convenient for "pusher" installation.) Ratchet needle-valve lock. Carburettor assembly behind engine for safe and easy adjustment. "Vandervell" main bearing. Weight 3.2 oz. B.H.P. 0.122 at 13,000 R.P.M.

Price **56/-** *inc. tax*



FROG '500 RG'

The only glow-plug engine in the Frog range. The "500" has been in production since 1949. Recent modifications have improved the performance up to the most modern requirement for this type of engine. It is particularly suitable for the larger R/C models and for large stunt C/L models. Extreme reliability. Excellent low-speed running for R/C use. Flexible needle-valve extension for safe, easy adjustment. Vandervell main bearing. Ball-bearing Thrust race. Ratchet needle-valve lock. Weight (with tank) 7¾ oz. B.H.P. 0.45 at 14,000 R.P.M.

Price **75/-** *inc. tax*

Ask for **SHELL SUPER 'POWA-MIX' FUEL** *and* **FROG PRECISION MOULDED AIRSCREWS IN NYLON AND HIGH IMPACT STYRENE**

INTERNATIONAL MODEL AIRCRAFT LIMITED
MERTON LONDON S.W.19 ENGLAND

PRODUCTS OF THE LINES BROS. GROUP OF COMPANIES

All about

MODEL AIRCRAFT

by

P. G. F. Chinn

A MODEL AIRCRAFT Handbook

FIRST PUBLISHED - - - - AUGUST, 1958

Made and printed in Great Britain by Electrical Press Limited Cordwallis Works, Maidenhead, Berks., for Percival Marshall and Company Limited, 19 and 20, Noel Street, London, W.1.

Contents

Foreword

"All About Model Aircraft" is just what its title implies. There is no other book published at the present time which covers the subject so completely, presenting each type of model in turn and describing their characteristics and construction in easily understood form—and at a price which all can afford.

This new book, consisting of twenty-four chapters, totalling over 50,000 words and with nearly 400 illustrations, has been made possible by using material previously published, during 1956-58, in *Model Aircraft*, the popular monthly magazine. It supersedes, and extends the scope of, the previous best-selling book by the same author, "How to Make Model Aircraft," which has been read by more modellers than any other book on this subject.

In dealing with model aeroplane construction, "All About Model Aircraft," like the earlier volume, is primarily intended for the guidance of newcomers to the hobby, but the more experienced model builder will also find much of interest in the latter half of the book and in such chapters as those dealing with radio-control, engine care and maintenance and fuel blending.

The author is known to modellers throughout the world. His articles appear regularly in *Model Aircraft* and the American model press and have also been translated and reprinted in many other countries.

Chapter One
INTRODUCTION

EVERY year, the hobby of building and flying model aeroplanes attracts thousands of newcomers and, every year, the range of different model types gets a little bigger and a little more bewildering to the beginner.

Just a generation ago, a model aeroplane was simply a " model aeroplane " and was easily recognisable as such, and its functions easily understood. It usually consisted of a wing and a tail-unit on a simple fuselage, propelled by a rubber motor. One simply wound it up and heaved it into the air and, with a little luck, it would fly, after a fashion, for perhaps twenty or thirty seconds.

Nowadays, our model aeroplane appears in a score or more of different guises. Its rubber motor has given way in most instances to an internal-combustion engine: it may be propeller driven or jet propelled; it may weigh just a few ounces or several pounds; it may span ten feet or less than one foot; it may fly at 15 m.p.h. or 150 m.p.h.; it may remain in the air for a minute or an hour; it may perform elaborate aerobatics under full control or it may lift a payload several times its own weight; it may be a scale model of some full-size aircraft or a strictly functional machine designed to do one particular job in the best possible manner. Finally, it may be flown free, or tethered or under radio control. No wonder beginners find the sheer scope of the hobby a little overwhelming and have difficulty in discovering where they should start.

We propose, therefore, to first describe and differentiate between the many types of aircraft now being built.

One thing we must make clear at the outset is the fact that, in spite of their impressive appearance, the sort of models shown in some of the accompanying photographs are *not* the work of genius. Model aircraft is not a hobby for the dullard or the featherbrained, but, given a reasonable amount of patience and commonsense, anyone can build a successful model and, with further experience will be capable of constructing quite advanced machines. This is because the material largely used in model aeroplane construction—balsa wood—is exceedingly quick and simple to work with, while the construction methods adopted, especially the widely used system of assembly over a full-size drawing, make for easy and accurate work.

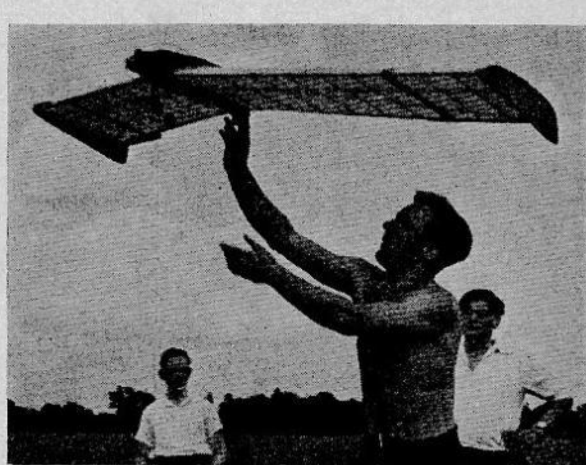
It is difficult to divide all types of model aircraft into precise groups because many of these overlap one another. Basically, however, we have three distinctly different groups, namely:

1. Free-flight models.
2. Control-line models.
3. Radio-controlled models.

The first includes all types of models which are flown quite " free ", depending upon their own good flying characteristics to maintain stable flight.

The second includes all models which are flown in

A typical modern rubber-driven competition model. Note the folding propeller. Built by Czechoslovakian enthusiast, V. Kutil.



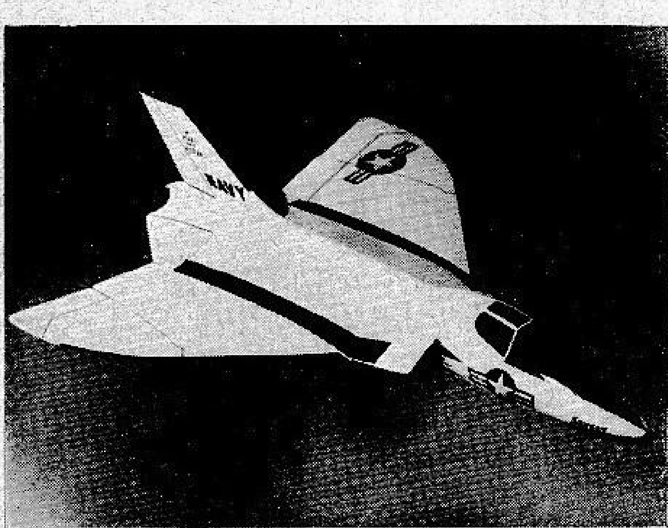
A free flight tailless power model being hand launched; note the tip fins and tricycle undercarriage.

a circle, tethered by means of a pair of thin control-lines. These lines are attached to a special handle held by the operator, while, at the aircraft end, they are coupled by means of a simple linkage to the elevators of the model. Thus, in addition to keeping the model captive, the control-lines, through movement of the control handle, serve to keep the model in stable level flight or, alternatively, to guide it through various manoeuvres, such as loops and inverted flight.

The third are essentially free-flight models in conception, but carry radio receiving equipment by which means they can be controlled by a transmitter operated from the ground.

Free-flight Models

(a) *Gliders.* Gliders, which are sometimes known also as sailplanes or soarers, are, of course, motorless aircraft. They can be launched by various means: by hand-launching from a suitable hillside, by catapult, by a winch and long towline, or by a running towline launch. The latter method is the most popular, a 50 metre (164 ft.) thin nylon or fishing line being most commonly used, which



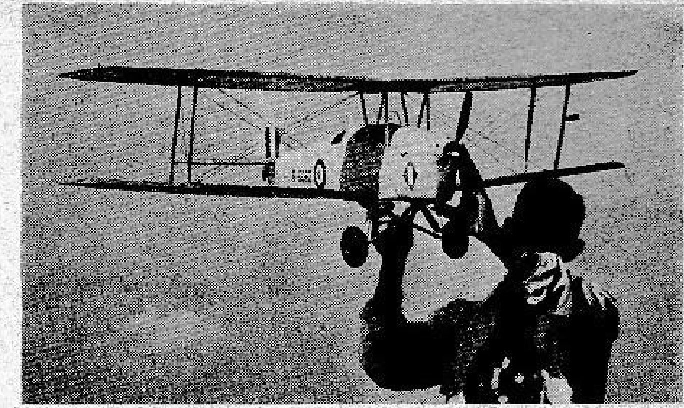
An attractive free-flight scale model of the U.S. Navy Skyray fighter. It is powered by a Jetex 50 motor and is available as a prefabricated kit.

allows a medium sized model to attain an altitude of around 150 ft. before release.

A popular glider of high performance is the International A2 type, which usually spans 5 - 6 ft. and weighs 14½ oz. For a first model, however, the beginner is recommended to build something smaller, i.e. of 2 - 3 ft. wingspan.

(b) *Rubber-driven Models.* Once the mainstay of the hobby, the rubber driven model has now been superseded in popularity by the engine driven model, but still has a place in international competition, where the Wakefield Trophy contest attracts some of the world's most capable model-builders. Rubber-driven models include, also, small, lightweight duration types and simple scale models.

(c) *Power-Duration Models.* The power-duration model is one of the most popular types of model aircraft. Seldom having much resemblance to a full-size aircraft, it is designed to climb to as great an altitude as possible in a given time (usually not more than 15-20 seconds) and to then glide for as long as possible. A typical contest type is the "International" class, limited to engines of 2.5 c.c.



Model flying is encouraged in the R.A.F. Here is Leading-Aircraftman Lock with his fine free-flight model of the well-known Tiger Moth R.A.F. trainer.

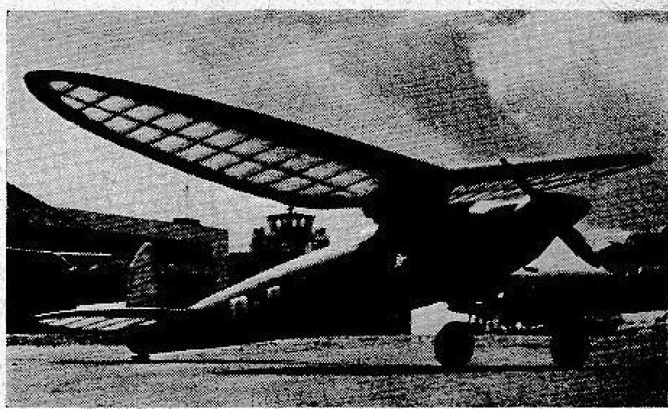
capacity. Some of these models climb faster than many full-size aircraft.

A development of the power-duration machines is the PAA-load type, built to a competition specification laid down by the Pan-American Airways. In this type of contest (for which P.A.A. award handsome prizes) the model is required to lift a regulation "payload" and a further development is the "Clipper-cargo" model, in which the winner is the model which can take-off and fly with the greatest possible load. A model powered by an engine of only .049 cu. in. (0.8 c.c.) capacity has, in one of these Clipper Cargo contests, lifted more than seven times its own weight.

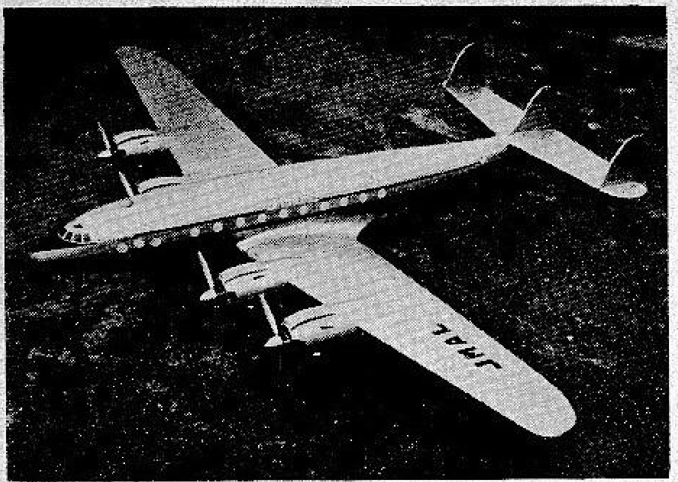
(d) *Free-Flight Scale Power Models.* These are models accurately scaled from full size aircraft, generally to a scale of 1in. or 1½ in. to the foot, producing models of 3-5 ft. wingspan and powered with motors of .5 c.c. (.03 cu. in.) to 2.5 c.c. (.15 cu.in). They are not recommended to the beginner, because they are more difficult to build and fly.

(e) *Beginners' Power Models.* There are now a number of non-scale, non-competition types of free-flight power models which are more suitable to the beginner than either of these previously mentioned types. Usually of semi-scale appearance, and easy to build, they are powered with motors of the "Half-A" class (.049 cu. in.) or up to a maximum of 1 c.c.

(f) *Jetex models.* The "Jetex" motor, which is available in several sizes, is a small type of jet or rocket motor. It burns a solid fuel pellet and is very suitable for small



Pictured against a background of full-size aircraft, at a Norwegian airport, is this attractive free-flight model powered by a 2.5 c.c. engine.



A fine example of a multi-engined scale controlline model. Built by a Japanese enthusiast, this impressive Lockheed Constellation airliner has four 5 c.c. engines which deliver a total of nearly two horsepower.

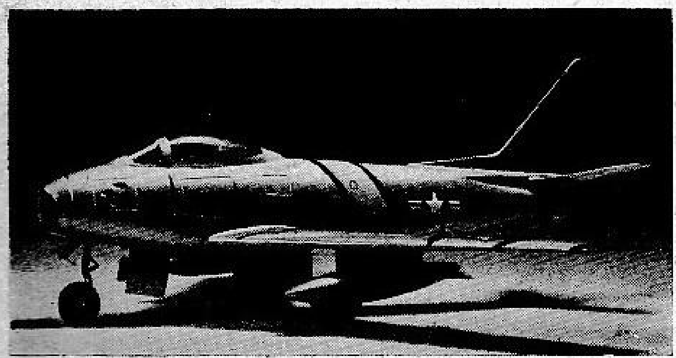
scale models (up to about 20 in. span) of modern jet aircraft or for lightweight duration designs.

(g) *Miscellaneous Types.* In addition to the previously mentioned models, there are many related and unorthodox types. For example, most free-flight power driven models can be equipped with float gear for rise-off-water flights. Alternatively, where one has access to smooth stretches of open water, the model flyingboat is a great attraction. Among the less conventional types are to be found helicopters, tailless and delta-wing aircraft, and almost every type of unorthodox full-scale aircraft has also had its counterpart in the model world. Such models are to be seen at most model meetings.

Control-line Models

(a) *Trainer Models.* The simplest controlliner can be built from solid balsa wood because all control-line models are heavier and faster-flying than free-flight types. Such models are quick and simple to build and easily repaired if damaged, and are therefore ideal for learning the rudiments of flying a C/L model. These models have a wing-span of 20-24 ins. and may be powered by an engine of up to 1.5 c.c. or .09 cu. in.

(b) *Stunt Models.* The aerobatic or "stunt" model is designed to perform quite complicated manoeuvres, such as loops, outside loops, inverted flight and vertical and overhead figures-of-eight. A typical modern American stunt model flies at 65-70 m.p.h. on 60-70 ft. long steel

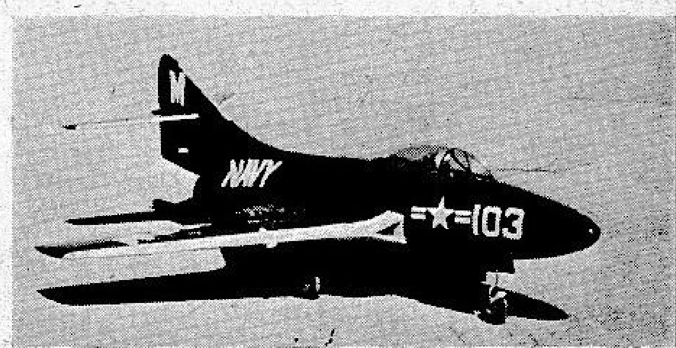


An excellent example of the scale modeller's art: an accurate and beautifully finished model of the American Sabre F.86F jet fighter with authentic markings.

control-lines and weighs 2-2½ lbs. It is generally powered by a glowplug-ignition engine of up to .35 cu. in. displacement (5.8 c.c.) developing about 0.5 horsepower. Its wingspan is usually about 50 inches and it can be recognised by its relatively large wing area and short fuselage. European models are mostly of somewhat smaller dimensions due to the smaller capacity engines available. Very considerable skill and judgement are exercised in successfully flying a stunt model through an elaborate pattern of manoeuvres.

(c) *Combat Models.* A popular development of the stunt model, usually of simpler design, is the combat machine. Two combat models are flown by their pilots in the same circle, each trailing a paper streamer, and the object is to pursue one's opponent and to cut as much as possible from his streamer with one's airscrew. Over-enthusiasm on the part of the pilots sometimes leads to spectacular mid-air collisions, and a model which is easy to repair, therefore, has much to commend it.

(d) *Speed Models.* Speed models are flown in various classes according to engine size. The most powerful are the 10 c.c. or .60 cu. in. engined models which achieve speeds as high as 160 m.p.h. from engines running at 16,000 to 18,000 r.p.m. and developing in the region of 1½ horsepower. Even tiny "Half-A" (.049 cu.in.) models have, however, now reached 100 m.p.h. Models built to

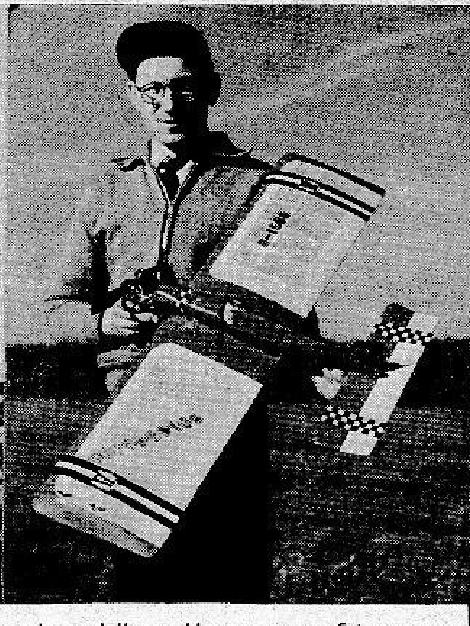


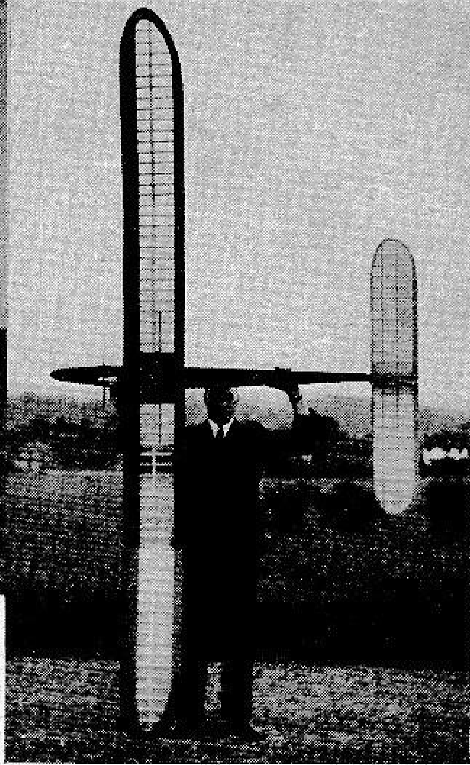
A true scale model of the Grumman Cougar jet fighter. Powered by a Dynajet pulse-jet engine of 4 lb. static thrust, it weighs 3½-lb. and has a speed of approximately 80 mph.

the F.A.I. World Championship specification have 2.5 c.c. engines and reach over 120 m.p.h. Speed models are quite small, even the largest being seldom more than 18 in. span. Much depends on reducing air drag to the minimum and to this end, a special mono-line system of control has been developed.

(e) *Team Racers.* In team racing, two, three, or four models are flown in the same circle simultaneously, the object being to cover a given number of laps (equal to five or ten miles) in the shortest possible time. Pure speed models, however, are not eligible for this type of event, as models have to fulfil certain minimum dimensions, be of scale appearance, and are permitted only a limited fuel tank capacity, which entails refuelling stops about every 40 laps. "Pit crews" refuel and restart the models during the race and with smart pit work, a fast .29 engined model will cover a ten mile race in less than 8 minutes, averaging 75 m.p.h. including the two refuelling stops required.

(f) *Scale Controlliners.* Scale control-line models are among the most impressive model aircraft. All types are constructed, from single-engined fighters up to four-engined airliners and bombers. Since control-line scale models can be so much heavier than their free-flight counterparts,





All types of aircraft are tackled by enthusiastic modellers. Here a successful power-driven model helicopter makes a flight over the Osaka baseball stadium in Japan. Centre: The "combat" model is designed for manoeuvrability and speed, rather than appearance. Here, Cpl. Godfrey of the R.A.F. displays his colourful model powered by a 5 c.c. engine Right: With a wingspan of more than 11 ft., this radio-controlled model represents many months of work.

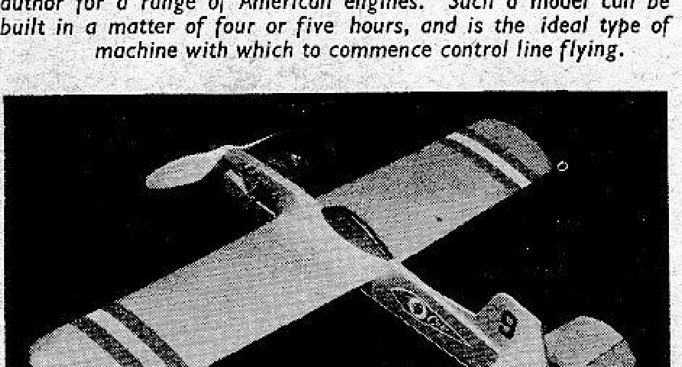
these models are often highly detailed, with working retractable under-carriage, etc. Such models are often in the super-scale class may be covered entirely with metallised paper, which gives an exceptionally realistic finish.

g. *Pulse-jet Models.* The pulse-jet is a powerful and extremely noisy power unit based on the principle of the German wartime V.1 " buzz-bomb ". Speeds approaching 180 m.p.h. have been reached with models so powered, but the most useful application of these engines is, undoubtedly, in scale models of modern jet fighters. In most countries, the use of these engines is restricted to control-line models only.

Radio-Controlled Models

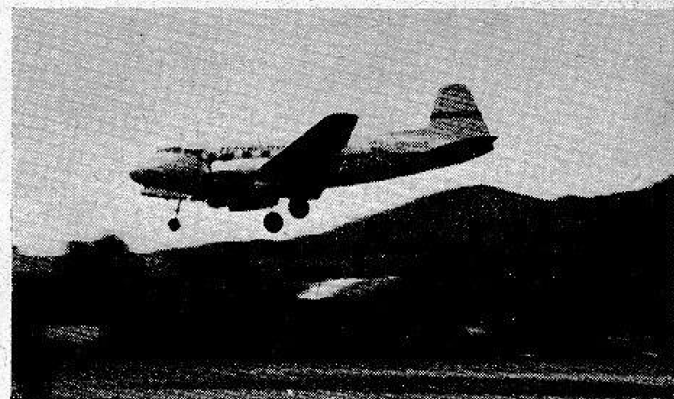
The radio controlled model is regarded by many as the ultimate in model flying and, without doubt, there is tremendous satisfaction to be gained from watching a model, flying at several hundred feet, respond to one's signals from a ground transmitter.

A simple 20 in. span all-balsa controlline trainer designed by the author for a range of American engines. Such a model can be built in a matter of four or five hours, and is the ideal type of machine with which to commence control line flying.



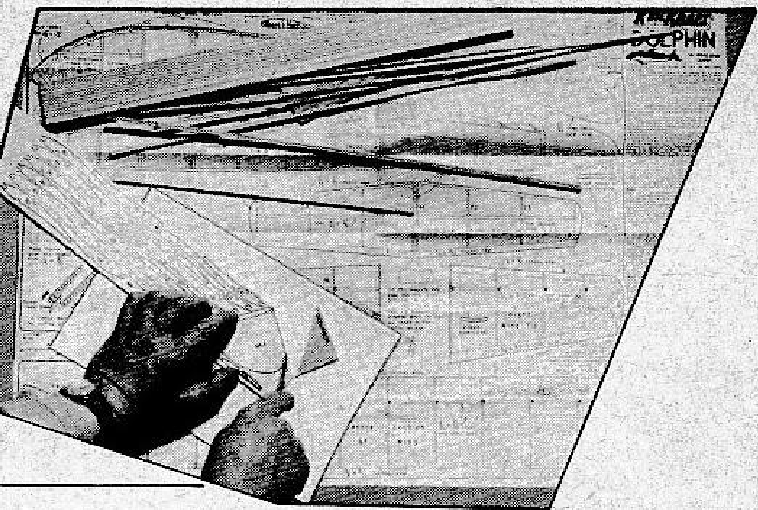
Radio models are divided into two types for competition purposes; (a) those having a " single-channel " control, which usually operates the rudder only, and (b) the " multi-channel " models in which engine speed and the elevators are also included in the control system. Miniature radio-control equipment for this type of model flying can be bought ready-made or one may build one's own transmitting and receiving equipment. In most countries the authorities have allocated special frequencies for the use of the radio-control enthusiast.

Looking just like a full-sized airliner about to land, is this twin-motor controlline scale model of a SAAB Scandia of Scandinavian Airlines.



To sum up, then, the model builder has an immense range of types from which to choose. While the majority of enthusiasts become so engrossed in their own particular sphere that they have little time for other types, it will be seen that there is, in fact, always something new to try, such is the scope of this fine hobby.

Making a Start



CHAPTER TWO

ALL model aeroplanes are built with the aid of full-size drawings or plans. These are a tremendous help. In most cases, the components of the models—fuselage, wing and tail-unit—are built directly over the plan. That is to say, the various strips of wood are pinned down over the plan and the glued joints allowed to set before each assembly is removed.

This system almost eliminates the need for measuring and marking the numerous wood strips, and greatly speeds and simplifies assembly work. It is also far more accurate and can be compared to the "jig" system of construction used in full-size aircraft manufacture.

The first requirement, therefore, is a full-size working plan of the model you wish to make. These can be obtained in three different ways. Firstly, you can buy a kit of materials and parts which will also include the required drawing. Secondly, you may build the model from a magazine plan (although this may require enlarging to full-size unless the model is quite a small one) or you can buy a full-size print from the publishers. Thirdly, you can design and draw up your own model.

Obviously, the latter course cannot be undertaken without a thorough knowledge of model aeroplane design and construction. Therefore, we need concern ourselves only with the first two and, of these, the kit model usually offers the greatest advantage to the newcomer.

Building from a manufacturer's kit is usually no more expensive, and, for a first model, is invariably a good deal cheaper than buying one's own materials. This is because balsa wood, etc., is sold only in standard lengths (usually 3 ft.) and, if a large number of short lengths of different widths and thicknesses is called for, it may be necessary to buy more wood than is strictly necessary.

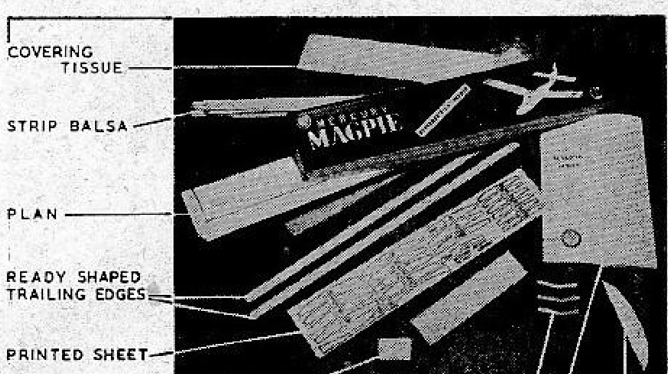
Another point in favour of a kit is that it eliminates some of the more repetitive work which the beginner may, at first, find a little tedious. For example, whereas, when building from bare materials, it is necessary to transfer patterns from the drawings or to make templates of sheet wood parts, these parts, in a kit, are usually printed direct on to the appropriate sheets of wood or are even ready cut out.

When buying your first kit, however, do not make the rather common error of choosing something advanced and complicated merely because the appearance of the finished model appeals to you.

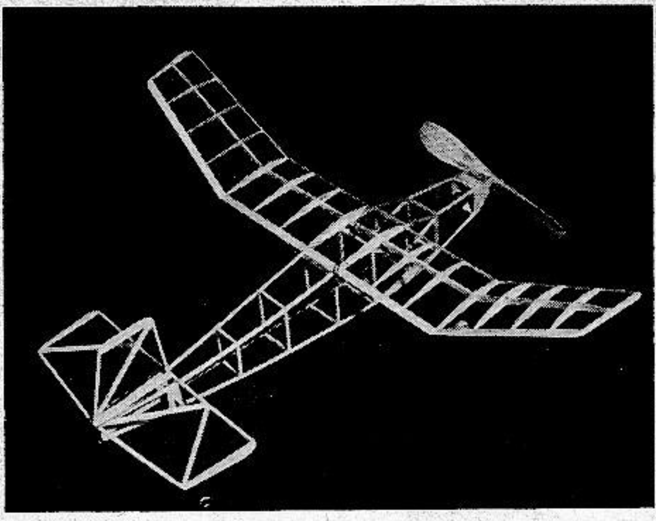
All model aircraft construction is really quite simple. All you need is a little patience and some practice. Therefore, build one or two simple and cheap models to start with. This advice may seem to be rather superfluous, but it is a fact that many beginners are apt to overlook the necessity for learning the simple techniques of model construction and, in doing so, to attempt something which would stand a much better chance of being successfully completed if left until some experience has been gained.

The type of model suggested for a first attempt is a simple built-up glider of 24-30 in. span. It is, of course, possible to make something even simpler, such as an all-sheet balsa glider, but only when you have built up a framework and covered it, can you really be said to have acquired some knowledge of model aircraft construction. There are on the market a number of built-up glider kits suitable for the beginner and new kits are being introduced by manufacturers continuously.

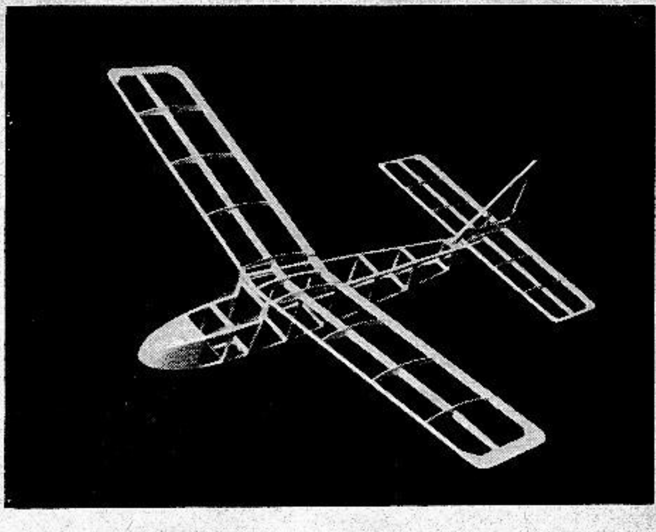
A word now about the basic materials used in model aircraft. The most important of all, of course, is balsa wood. Balsa is wonderful material, it is very light and



TYPICAL BEGINNER'S BUILT-UP GLIDER KIT



Rubber-driven model with built up fuselage. (Skyleada Fledgeling.)



Beginner's glider with built-up fuselage. (Mercury Magpie kit.)

quite soft, so that we rarely need anything more than a razor blade to cut it. Yet it is strong and rigid enough for our purpose because, where necessary, quite thick sectioned balsa can be employed without risk of making the model too heavy, and impairing its flying qualities.

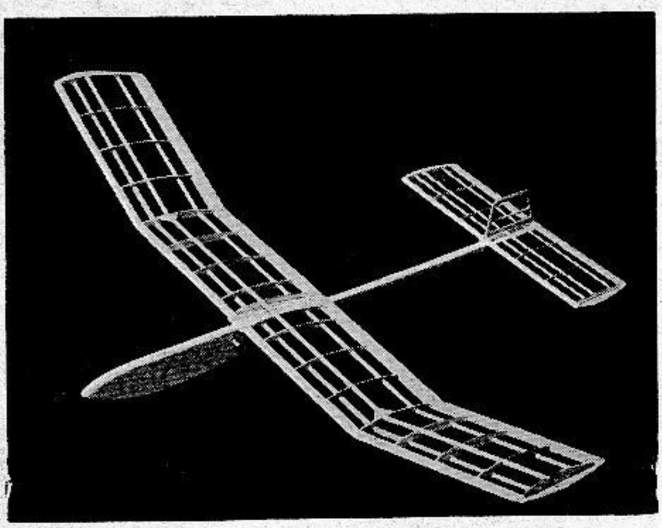
Balsa is sold in so many different sizes that it is very seldom that we even need to plane or saw it. The most popular strip sizes are the 1/16 in., 3/32 in., 1/8 in., 3/16 in. and 1/4 in. square sections. Flat sections, such as 1/16 in. × 1/4 in. and 1/8 in. × 1/2 in. are also obtainable. Larger sizes are also available, but, when more than 1 in. square, are usually classified as "block," rather than strip, balsa. "Sheet" balsa, usually 2 in. or 3 in. wide and 3 ft. long, is also very widely employed and is available in various thicknesses, 1/32 in., 1/16 in., 3/32 in., 1/8 in., 3/16 in. and 1/4 in. being popular.

Balsa for model use is also sometimes graded into various "weights" and "cuts." Balsa wood grows in tropical climates, much of it being imported from Ecuador and it varies a good deal in density and also (depending on the direction in which the logs are sawn to produce different grain formations) in the rigidity or flexibility of sheet stock. However, this is of no immediate importance to the beginner: hard balsa is heavy and soft balsa is light and, at this stage, we need concern ourselves only with the choice of "hard," "medium," or "soft" wood, as and when specified in the plans or instructions.

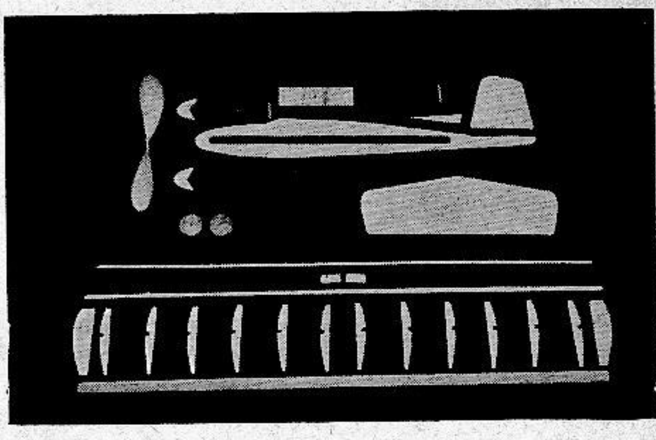
Thin, high-quality bonded plywood (known as "aircraft ply") has certain uses, particularly with larger models and power driven types. It is generally sold, at model shops, in small panels and in thicknesses of 1/32 in. upwards.

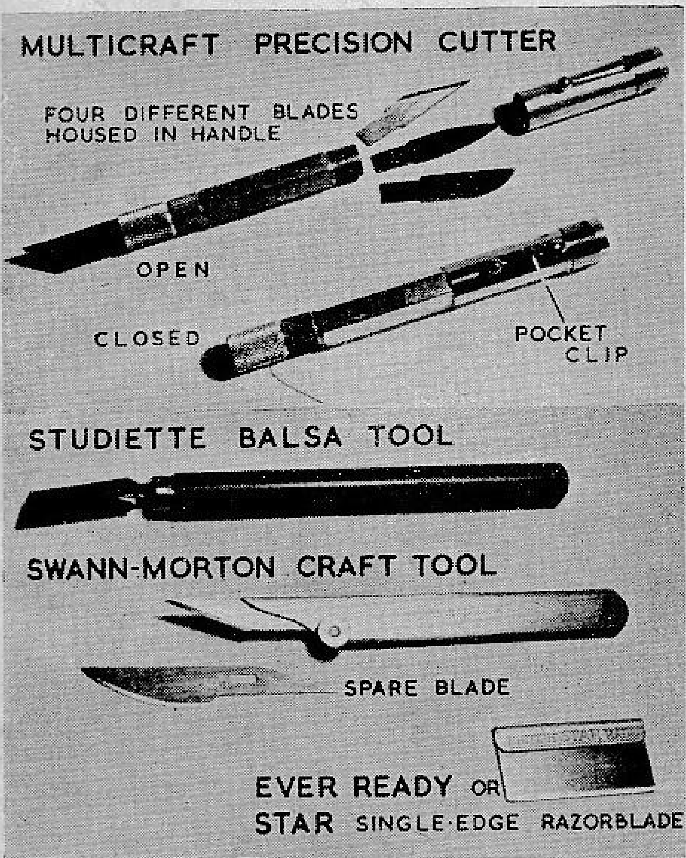
Other woods have only very limited uses in model aircraft work. Obeche is occasionally used by some designers, being available, like balsa, in strips and sheets, but its usefulness is limited, as it is two to three times the weight of balsa. Spruce and birch, much stronger in small sections than balsa, are used by some Continental modellers for wing spars in the thin sectioned wings of high performance competition gliders. Ash and beech are often used for engine bearers and the latter wood is also widely employed, by manufacturers, for power model propellers.

Thick spring-steel wire of 1/16 in. to 1/8 in. diameter is employed for undercarriage structures and for rubber model propeller shafts. Medium wire (1/32 in. to 1/16 in.) is used for rubber models and for control-line model control systems. Very thin wire, down to .006 in. diameter, is used for control-lines and for small springs, etc. Other metals, mainly brass, aluminium and duralumin in sheet, strip and tubular form, have useful applications, particularly in power models.

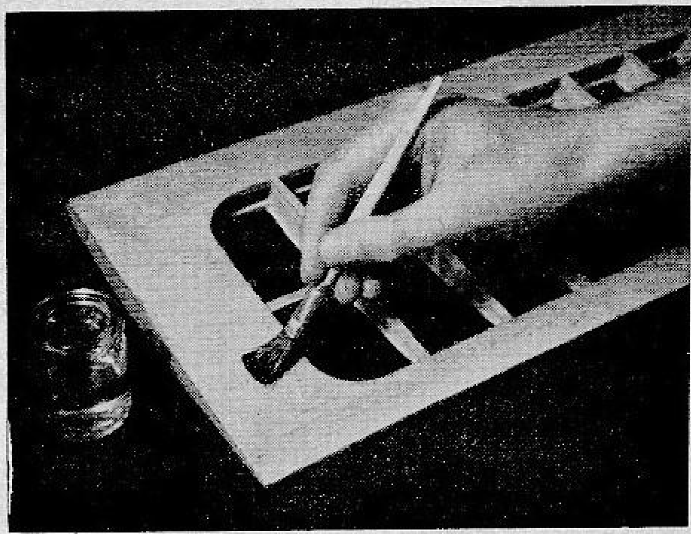


Left: Beginner's glider with profile fuselage. (Mercury Gnome kit.)
Below: Beginner's rubber-driven model with profile fuselage. ("Model Airplane News" magazine plan.)





Various types of model knives and the ubiquitous razor-blade.



Brushes. Buy good quality for doping the covering, but a cheaper variety is good enough for bare wood.

Second only in importance to balsa in helping us to make models quickly, cleanly and accurately, is the type of "glue" used—actually an extremely quick-drying cellulose cement. A simple butt-joint made with balsa cement is dry in a matter of a minute or two and hardens rapidly. Because of this, assembly can be carried out more or less continuously, there being no occasion to "wait for the glue to dry."

Covering materials consist of lightweight (Japanese) silk, nylon and various types of tissue papers, including the special tissues for model work, such as "Modelspan" (British) and "Silkspan" (American). These latter are available in special "heavyweight" grades for the larger types of power models.

Silk is not generally employed in F/F models weighing less than 2 lb., but can be used profitably (being stronger than the tissues) on C/L models of 20 oz. weight and upwards, and also on radio-controlled models. Nylon has the greatest strength and can be employed to great advantage on large R/C models.

These covering materials are attached to the framework with various types of adhesives, which will be described later. After covering, the material is water shrunk and is also "doped" to give it a smooth drum-like surface which, incidentally, also greatly strengthens and stiffens the structure, and renders it airproof.

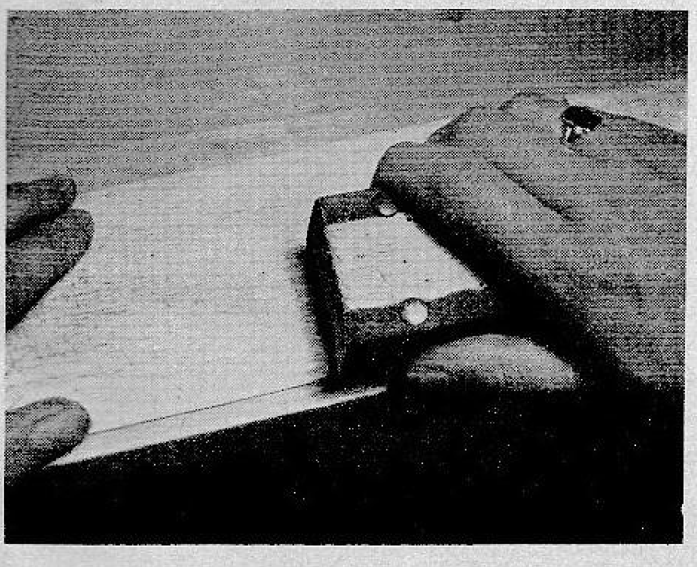
The model aircraft builder is fortunate in that his hobby requires the use of only a very modest tool kit.

To build an elementary kit model, for example, will require an old razor-blade or modelling knife, a small piece of sandpaper (sometimes included in the kit) and a brush for applying the dope. The use of a pair of pliers may be required if there are any small wire parts—such as towhooks—to be bent to shape.

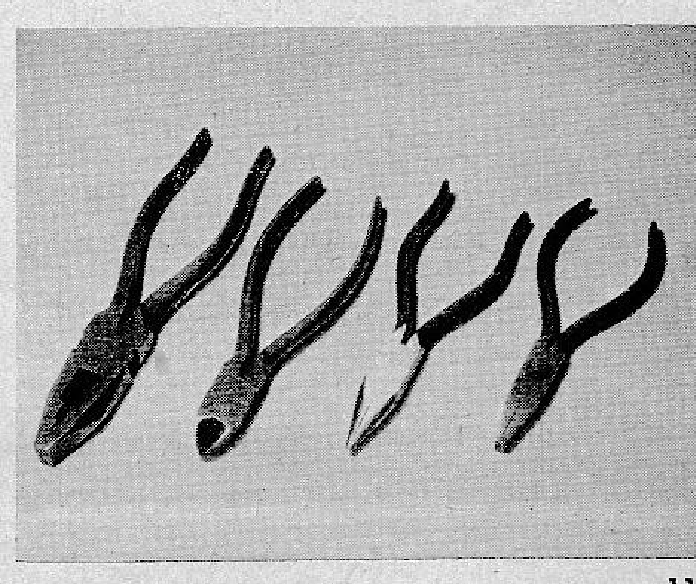
However, as the modeller progresses, especially if he begins to specialise in power models, a few simple tools will be found useful.

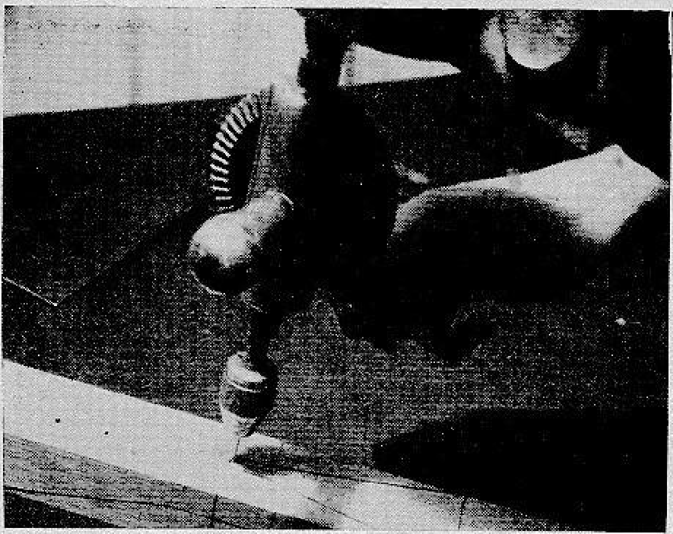
We have mentioned the razor-blade. This is, in fact,

Second in importance to the razor-blade, the sandpaper block.



Comb. pliers, side-cutting nippers, round-nose and flat-nose pliers.





A small hand-drill will be found useful.

still one of the most commonly used tools. Even if one possesses a most comprehensive range of modelling knives, the steel-backed single edged razor-blade is still one of the most useful items. However, for getting into corners and rounding sharp curves, a pointed blade is sometimes required, and here one of the wide selection of modelling knives, such as the "X-acto" series, "Studiette," "Ragg," "Multicraft" and "Swann-Morton" will be found very handy. Saws are seldom needed, but a useful tool for making straight, smooth cuts in block balsa or for cutting plywood and other harder materials is the "X-acto" razor-saw. Uses for a fretsaw or coping saw may occasionally be found.

A small supply of sandpaper of the finer grades is invaluable. In most cases, the sandpaper should be pinned around small blocks or strips of wood. For use on balsa, sandpaper blocks will usually take the place of files and rasps, although one or two small files will come in handy for use on metal parts.

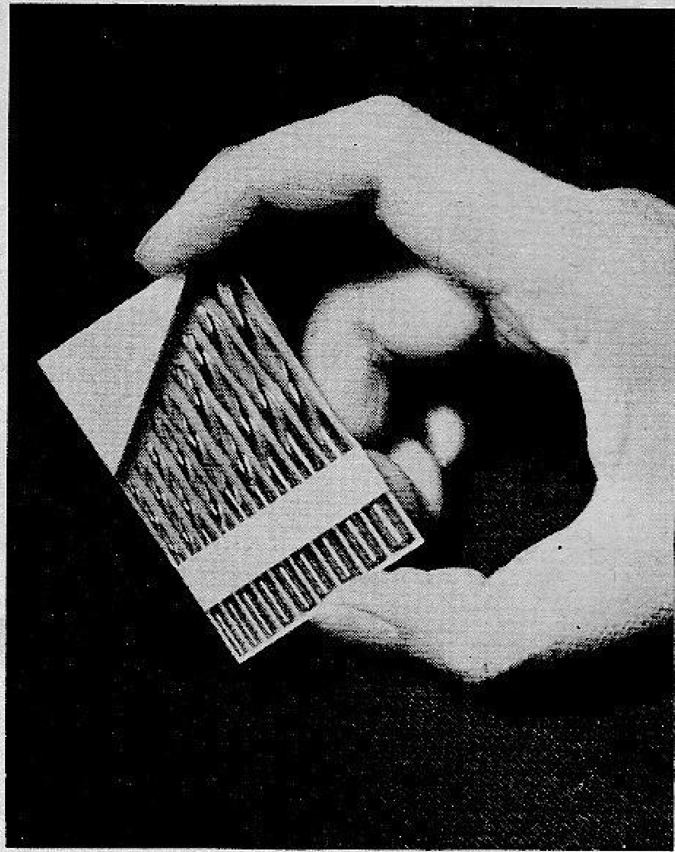
A small hand-drill, having a 1/4 in. chuck, is a worthwhile addition to one's tool kit. Drills should be of the smaller sizes, the most useful being 1/16 in., 5/64 in., 3/32 in., 7/64 in., 1/8 in., 5/32 in. and 3/16 in. Instead of buying these separately, it is possible to purchase, much more cheaply, a set of "short" modeller's drills.

Brushes for finishing should invariably be of the soft sable or camel hair mop type, but a cheaper kind can be employed for applying dope and grain filler to wood surfaces. One or two small artists' brushes are handy for applying decorative trim.

A bench vice is a useful item and, except for bending very heavy steel wire (such as for large power model undercarriages), one of the "universal" pattern, in which small parts can be held in almost any position for cutting, filing or bending, is a pleasing addition to one's gear.

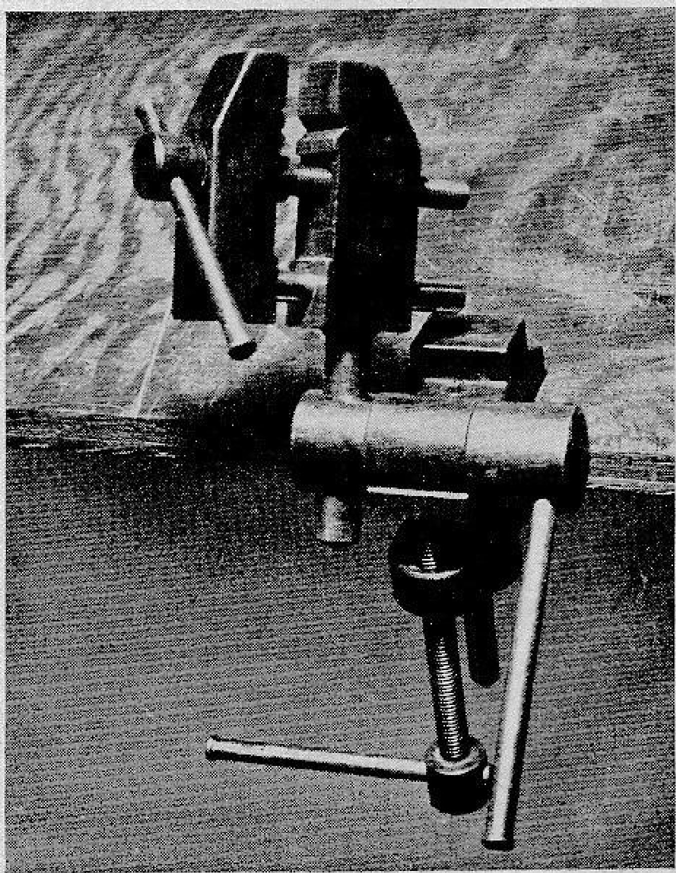
A good strong pair of combination pliers can generally be found in most households. Beyond these, a pair of round-nosed, or "radio," pliers are of great help in forming small wire fitments, and a worth-while luxury is a pair of really good side-cutting nippers which will bite through medium and thin wire cleanly.

If one later specialises in power driven models, one or two simple tools will be required for work on engine installations, etc., namely a small screwdriver and one or two small spanners (usually B.A. sizes in Britain) for engine mounting bolts, etc.

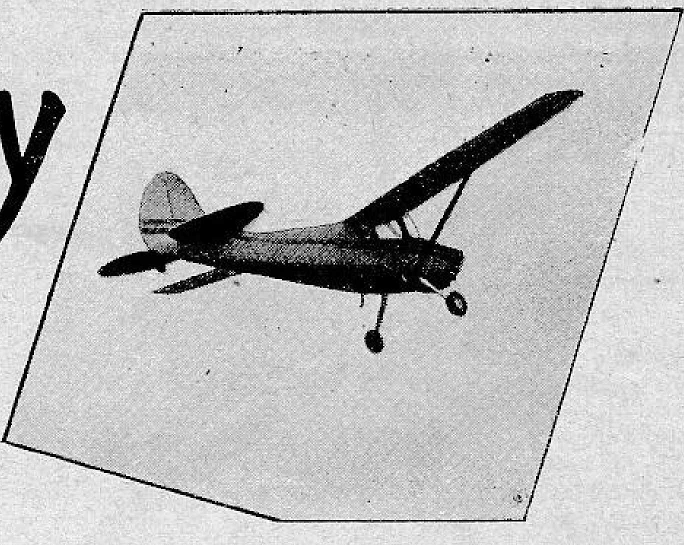


Above: A set of inexpensive short twist-drills suitable for model use.

Below: If a vice is to be obtained, the universal type shown is well suited to the model-maker's requirements.



Flight Simply Explained



IN the previous pages, we described various types of models, building methods, materials and tools. In this third chapter, it had been our intention to go straight on to the building of an elementary glider. Instead, we have decided, at the risk, perhaps, of disappointing some of our new readers, to first introduce a chapter on the elementary mechanics of flight—in other words, to simply explain how the aeroplane flies.

CHAPTER THREE

Our purpose here is twofold. Firstly, it enables us to introduce to the reader the names of the various parts of an aircraft, so that he will be familiar with these without our having to explain them in later chapters. Secondly, as some idea of the basic principles which govern stable flight is essential if one's first effort is not to be quickly reduced to a pile of wreckage, this seems to be the best point at which to bring them forward; i.e. *before* building a model, so that, even if you do not thoroughly digest, now, everything we have to say here, and even though we shall not deal with detailed trimming adjustments until later, you will be forewarned on one or two points. Most newcomers to the hobby are anxious, just as soon as they have built a model, to go out and fly it without more ado, and one can, perhaps, forgive the over-enthusiasm which causes them to read about the hows and whys of flight only *after* they have attempted to fly a model.

In Figs. 1 and 1a are shown the names of the main parts of an aeroplane. In some cases, there are two or more names for the same part. This is often due to differences in British and American usage, For example, the landing wheels and struts are usually known in Britain as the *undercarriage*, but, in the U.S.A., *landing-gear* is the term more commonly applied. Similarly, the English *tailplane* becomes the American *stabiliser* or "stab." American seamen do not talk of "port" and "starboard" and these, which, like so many aviation terms, were derived from nautical terminology, have, in any case, become rather less commonly used in model aircraft circles, so that it is quite permissible, instead, to talk simply of "left" and "right."

In our hobby, too, there is considerable freedom in the use of alternative names for certain parts. A side strut between two longerons, for example, may be called a

Figs. 1 and 1a. The basic parts of a model aeroplane.

FIG. 1.

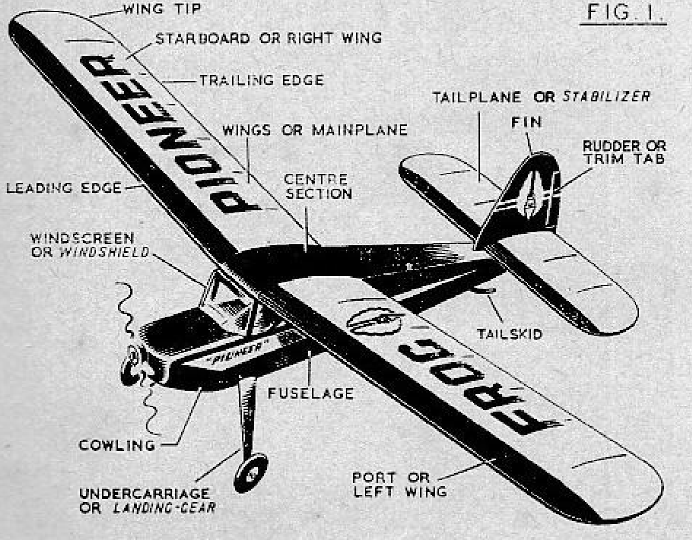


FIG. 1A.

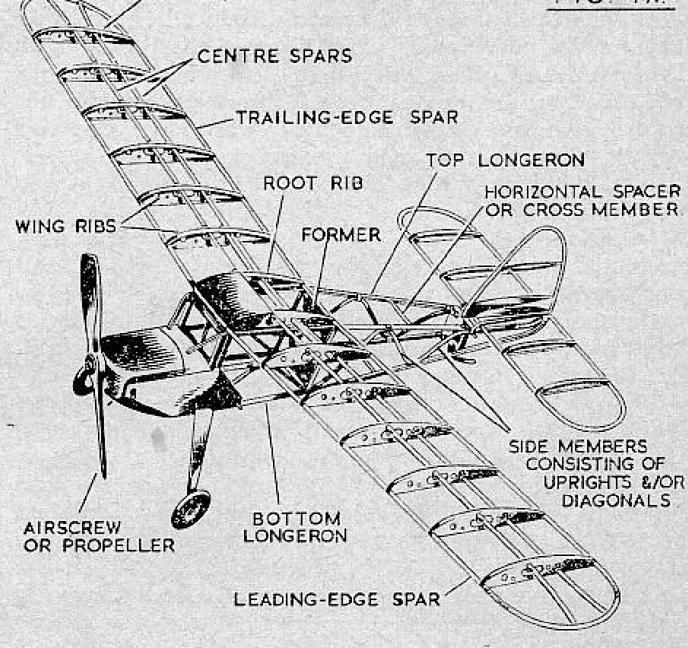


FIG. 2.

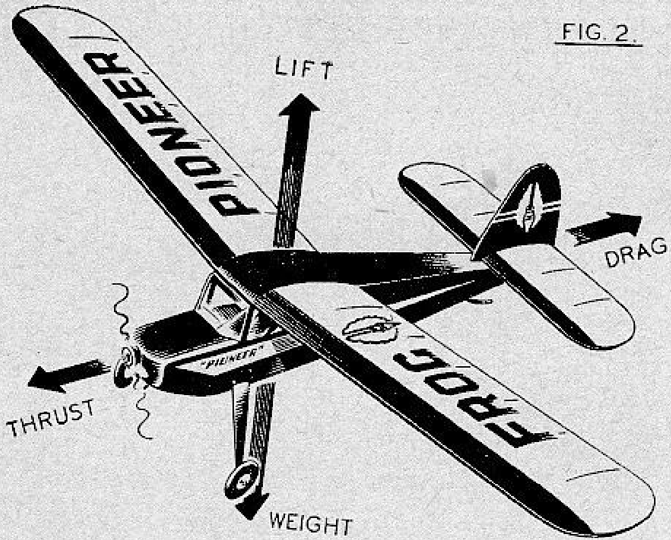


Fig. 2. The Four Forces. In steady flight, drag equals thrust and lift equals weight.

vertical spacer, an *upright* or a *side member*, or even variations and combinations of these terms. *Longerons*, however, which are main longitudinal members, should not be confused with *stringers*, which are light auxiliary longitudinals whose main purpose is to support the outer covering and preserve the external form of the fuselage or other component.

The Four Forces

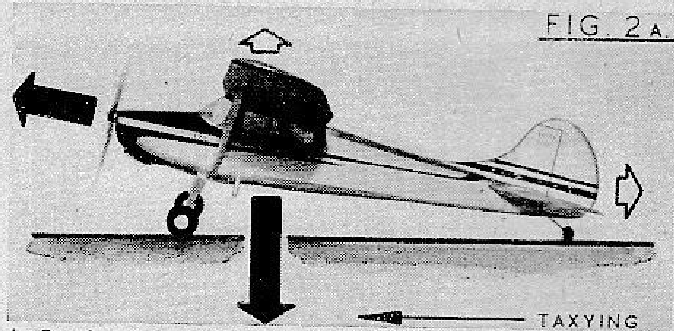
We have said that this will be a chapter on the elementary mechanics of flight. What we want to do is to explain as simply as possible the basic principles of aeroplane flight without getting the reader too involved with aerodynamics. Any treatise on the first principles of aerodynamics usually starts off by describing, with the aid of diagrams, the reaction produced by moving a flat plate through the air and develops the theme from there. We have discarded this rather formal approach by starting, instead, with the four main forces acting on an aeroplane. From this we shall show how stability is obtained and we have illustrated the various points with photographs.

Fig. 2 shows the four main forces acting on an aircraft in flight. First, there is the *thrust* (produced either by an airscrew or jet motor) which moves the whole craft through the air. In opposition to this force is the *drag*, the resistance to forward movement produced by the air. Thirdly, we have *lift*, which is the upward force generated by the wings due to their movement through the air. Lastly, we have *weight* or the force of *gravity*, acting downwards.

In steady level flight, the forces of thrust and drag are equal and the lifting force equals the weight. Read this sentence again. Some people find it difficult to understand that this should be so and assume that thrust must be more than drag and that lift is more than weight. Let us explain in more detail.

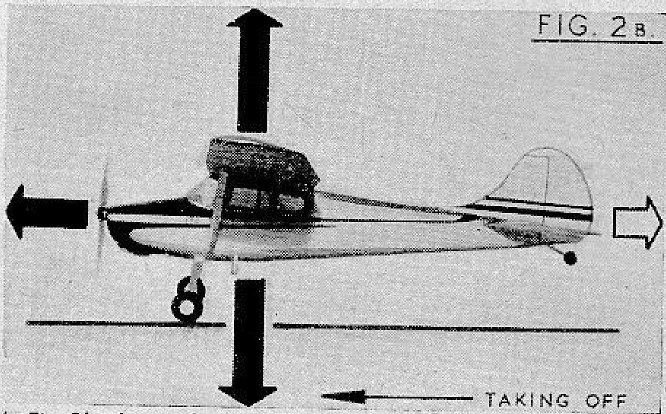
When an aeroplane begins to taxi along the ground, the thrust is many times the drag and the weight many times the lift. (Fig. 2a.) As the aircraft moves faster, however, the differences are lessened. When a certain speed is reached, the lift equals the weight (Fig. 2b) and then exceeds it and, immediately this happens, the aircraft leaves the ground and begins to climb. Now that ground resistance is eliminated, the aircraft continues to accelerate until the drag equals the thrust. The speed will now

FIG. 2A.



In Fig. 2a, the aircraft has just moved off from a standstill and lift and drag are small due to low speed.

FIG. 2B.



In Fig. 2b, the machine is accelerating and is just about to become airborne.

FIG. 2C.

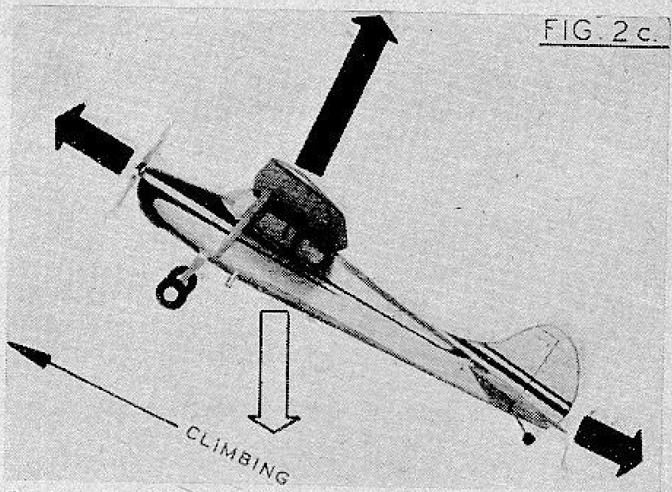


Fig. 2c. Model is climbing rapidly. Note that the "lift axis" is not truly vertical.

FIG. 2D.

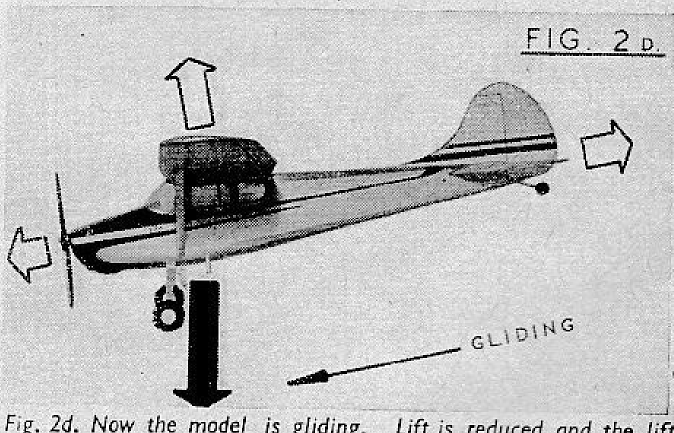


Fig. 2d. Now the model is gliding. Lift is reduced and the lift axis is inclined forward.

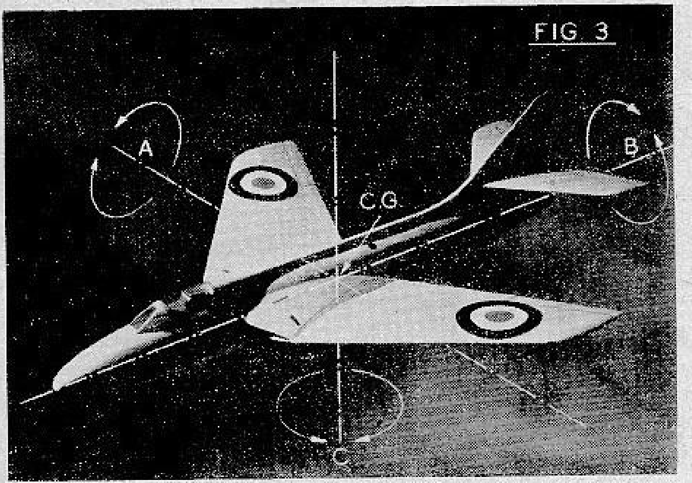


Fig. 3. The Three Axes about which Longitudinal, Lateral and Directional Stability are obtained.

remain constant and so will the rate of climb. Therefore, we now have thrust and drag equal, but the lift force greater than the weight. (Fig. 2c.)

Now here is the essential difference between a model and the flight of a full-sized aeroplane. Our model goes on climbing until the engine stops. The pilot of the full-sized aeroplane, however, who is usually interested only in getting from one point to another, levels out his aircraft and reduces his engine speed until lift equals weight and the aircraft flies at a constant speed and altitude.

Suppose now that the engine of our model stops. Thrust is lost. Drag will slow up the aircraft and lift will thus be reduced. Weight will now cause the machine to descend. Will it just plummet to earth? No, because drag will limit its speed and the wings will still generate enough lift to cause a gradual descent, i.e., a *glide*, provided that the aircraft continues to travel nose first and does not become unstable. (Fig. 2d.)

How is this stability ensured? For this we have to look to the Three Axes.

The Three Axes

Like every other solid object, the aeroplane has a *centre of gravity* (see Fig. 3) and whenever it points upward, downward or sideways, or rolls to the left or right, it does so with the centre of gravity as a pivot point. And so, for the purpose of studying stability, we declare the aeroplane to have three *axes*, marked *A*, *B* and *C* in Fig. 3.

Axis *A* is known as the *lateral axis*. The nose-up and nose-down movements that that aircraft makes with this line as a centre point are called *pitching*. Axis *B* is the *longitudinal axis* and when the machine banks left or right, this is called *rolling*. Axis *C* is called the *normal axis* or *vertical axis* and directional movements left or right are called *yawing*. Pitching, rolling and yawing. Once again, terms of nautical origin.

Longitudinal Stability

Now, our first requirement is longitudinal stability, which concerns pitching. A little confusing, perhaps, but we must remember that this takes place about the lateral axis—not the longitudinal axis.

We have seen that a wing produces lift when moved through the air. The amount of lift it produces depends primarily on the speed at which it travels and its angle to the airstream, called the *angle of attack*.

Now, there is a point, relative to the width or *chord* of the wing, through which the lifting force is concentrated. This is called the *centre of pressure*. The position of the centre of pressure is not constant. At a zero angle or very low angle of attack, the centre of pressure is near the mid-chord point. At high angles of attack it is nearer to the leading edge. At negative angles of attack, the centre of pressure moves towards the trailing edge.

We can see that this presents rather a problem.

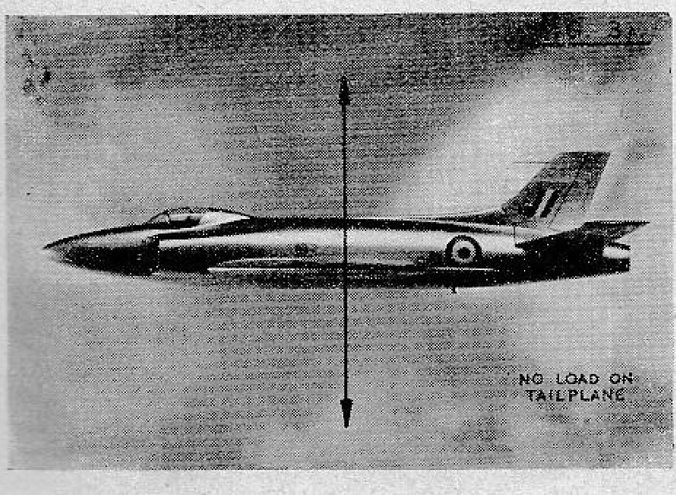
Let us suppose that we have balanced the aeroplane so that the centre of gravity is immediately below the centre of pressure at the required angle of attack. The two opposing forces are now in equilibrium: the lift directly opposing the weight.

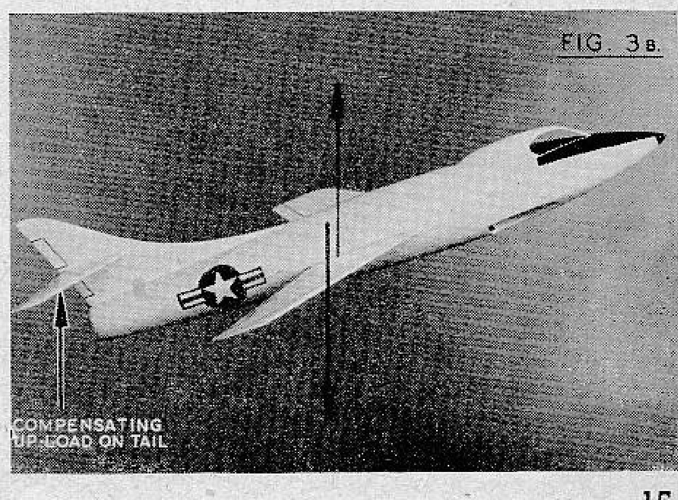
However, if anything occurs to alter the angle of attack, i.e., if the aeroplane pitches, stability will be lost. If the nose rises, the centre of pressure will move forward in front of the c.g. *and thus tend to lift the nose still more*, in turn causing the centre of pressure to move yet farther forward, so that the wing will tend to rotate completely and turn the aeroplane over on its back.

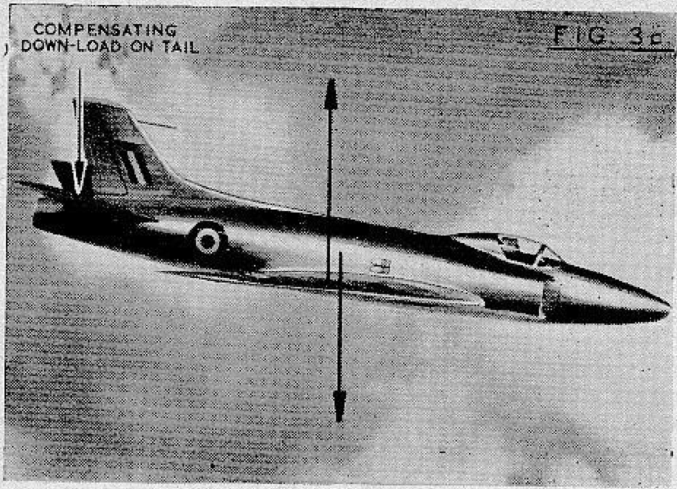
This is where the *stabiliser*, as the Americans so sensibly call it, or *tailplane* comes to the rescue. The tailplane is merely another, much smaller, wing attached to the rear end of the fuselage, to *stabilise* the main wing.

In constructing our aeroplane, we can now mount the wing on the fuselage at a suitable *rigging angle*, or *angle of incidence* so that, in normal flight it is inclined at such an angle of attack as to produce the required amount of

In Fig. 3a, we see steady flight with the centre of lift immediately above c.g. In Fig. 3b, the nose has been deflected upward, resulting in the centre of lift being moved forward. Upward corrective force by tailplane restores balance.







In Fig. 3c, nose is deflected downward. Centre of lift moves back. Downward corrective force by tailplane restores balance.

lift. We can then arrange that the c.g. should approximately coincide with the centre of pressure at this angle of attack and we mount the tailplane at zero degrees so that it merely " floats " in the airstream. (Fig. 3a.)

Now, suppose that flight conditions are disturbed in such a way that the nose is raised. As before, the centre of pressure of the wing moves ahead of the c.g. and tries to make matters worse. But now, our tailplane, which, hitherto, has had no hand in the proceedings, is also inclined at a positive angle and also begins to generate lift. And because it is situated at the end of the fuselage, it exerts great leverage which, acting through the lateral axis, restores the aircraft to level flight. (Fig. 3b.)

Conversely, if the nose of the aeroplane should drop, the tailplane will now assume a negative angle and generate a downward load behind the lateral axis, thus restoring level flight again. (Fig. 3c.) And so we have achieved longitudinal stability.

Lateral Stability

Lateral stability is achieved in quite a simple manner. If you look at an aeroplane head-on, you will see that the wings are not usually horizontal from tip to tip, but are inclined upwards at the tip to form a shallow *dihedral angle.* (Fig. 3d.)

Now, it is not too difficult to grasp the fact that the more we incline the wings upward like this, the less will be the lift in a vertical direction that they generate. However, a roll to right or left also causes a sideslip in the direction of the roll. This is due to the fact that a small sideways force is introduced by the entire lift being inclined sideways instead of acting in direct opposition to gravity.

Dihedral now acts as the correcting force. In moving sideways as well as forwards, the lower surface of the wing presents considerable resistance to the inclined airstream and thus tends to roll the aircraft back on to an even keel.

Directional Stability

The basic method of ensuring directional stability is to place more side area behind the vertical axis than in front of it. This is the reason for fitting a vertical tail fin. The principle can be likened to that of a weather vane.

When an aircraft is thrown off course and yaws to one side, it continues momentarily in the same line of flight and is therefore flying slightly crabwise. Thus, the airstream is striking one side of the aeroplane and, in striking the considerable area of the fin, the machine is turned back in line with the direction of flight, just as a weathervane is swung into the airstream when the direction of the wind changes.

The C.G. and How to Find it

Some modelling wag once wrote a treatise picturesquely entitled (if memory serves correctly) " The Elusive Cee-Gee Crittur " . . . Facetious comment on how to find the c.g. and what to do with it when you have found it are legion in modelling circles. Every sort of humorous suggestion—from imprisoning the c.g. in a matchbox and hanging it from the undercarriage, to doing away with it altogether—has been put forward.

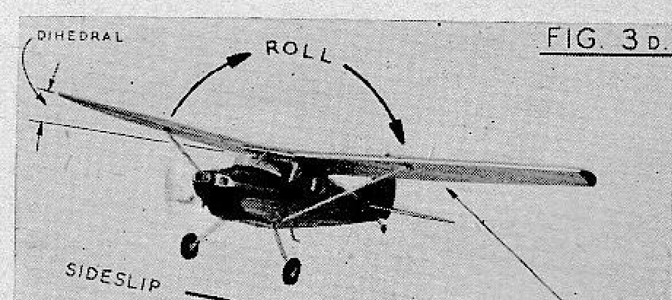
But, seriously, as we have said, every solid object has a c.g. and, so far as aircraft are concerned, we usually need to know where it lies. It is the first thing we need to determine, for example, before we attempt to fly a new model, when, if necessary, we ballast the model in order to re-locate the c.g. according to the design requirements.

When talking of models, one frequently refers to the position of the c.g., relative to the wing chord; for example: " 40 per cent. chord," meaning that the c.g. is vertically in line with a point four-tenths of the distance back from the leading edge. The simplest way of finding out whether a model is correctly balanced longitudinally is, in fact, to lift it with the finger tips placed in the appropriate position under the wing. However, this establishes the balance in one dimension only and, though we may assume that the aircraft is properly balanced about its longitudinal axis, we still do not know the vertical position of the c.g. It is sometimes desirable to know this precisely, especially, for example, when determining the tow-hook position on a glider. The process is simple and is as follows.

Firstly, hang up the model slightly in front of the estimated balance point. The machine will hang at an angle, tail downward. From the point of suspension, draw a vertical pencil line down the side of the fuselage—preferably with the aid of a simple thread plumb-line.

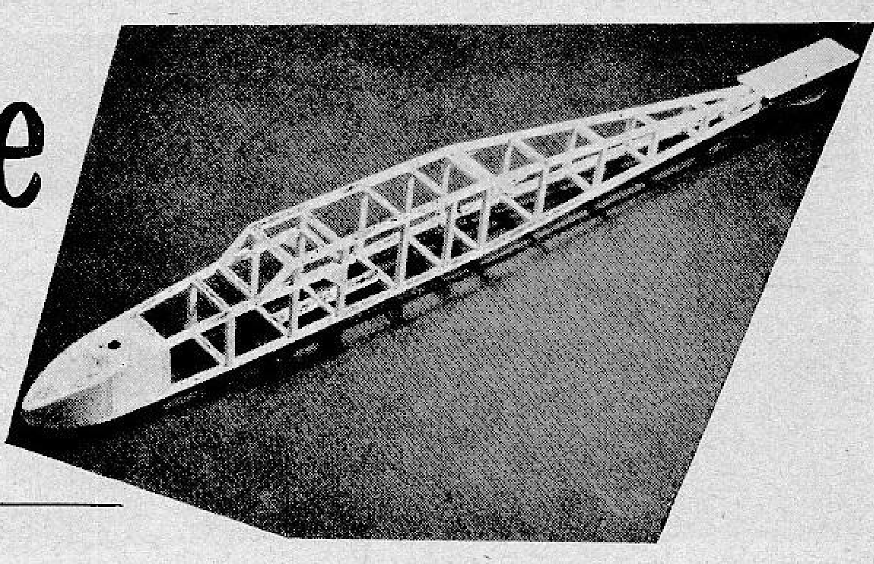
Now suspend the aircraft from a point rearward of the estimated balance point. The model will now hang at an angle, nose downward. From the point of suspension, draw another vertical pencil line down the side of the fuselage.

Where these two lines intersect, establishes the c.g.



In Fig. 3d, we see how the lateral dihedral angle of the wings maintains lateral stability. (Models used in photographs for this chapter: Keilkraft " Cessna 170," Jetex Hawker " Hunter," Supermarine " Swift " and Douglas " Skyrocket.)

Making the Fuselage



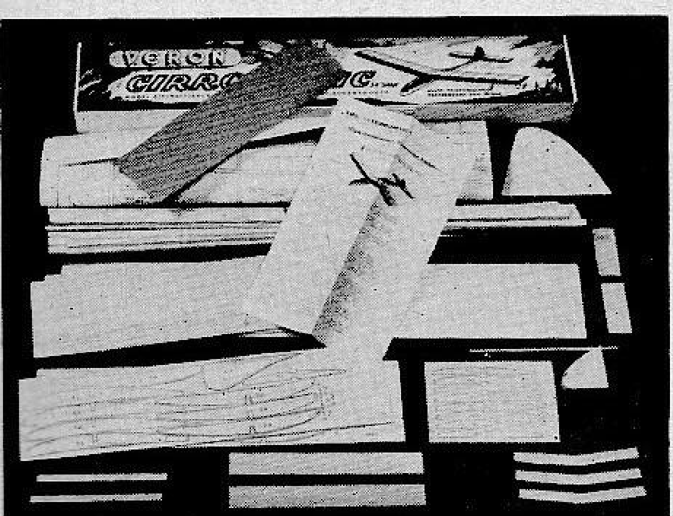
THE most widely used form of fuselage construction is the simple box framework. For rectangular section fuselages, it is the standard method employed and is also commonly used where other cross-sectional shapes are involved. In the latter case the addition of stringers, with or without extra formers, over the basic box structure, completes the skeleton framework.

CHAPTER FOUR

There are, however, many other types of construction—in fact, the variety is almost limitless. Popular in the early days of model aeroplanes was the "stick" or "spar" model in which the "fuselage" was nothing more than a thin wooden stick. Nowadays, equivalent simplicity is obtained with "profile" models, the fuselage consisting merely of thick sheet balsa wood cut to a suitable side view shape. There are also variations on this idea, one example being the Mercury *Gnome* glider in which the nose part of the fuselage is built up as a flat outline of $\frac{1}{8}$ in. × $\frac{3}{8}$ in. balsa sandwiched between two $\frac{1}{16}$ in. sheet balsa sides, but with a solid spar tail boom. A little more advanced is the system used on the Veron *Cirro-Sonic* in which the complete fuselage is made up of a simple framework of $\frac{1}{8}$ in. × $\frac{3}{8}$ in. strips assembled on edge over the plan and then covered by $\frac{1}{16}$ in. sheet balsa sides. This produces a very strong structure, is easy to build and has a better appearance than the normal profile fuselage. The *Cirro-Sonic* kit is, in fact, an excellent choice for a first or second model. It is easy to build and, with a wing area of over 200 sq. in., a good performance is assured if reasonable care is taken to build accurately.

Another form of fuselage construction is the semi-sheet balsa type, which uses sheet balsa sides connected by formers and cross members. Popular with some designers is "crutch" construction in which a flat base structure of two longerons and a number of cross members is first built up and to which is then added formers and additional longitudinal members.

The "backbone and half-former" method of construction is a short step from here and consists of top and bottom "backbone" and "keel" members to which are added half-formers and stringers. Alternatively, the half-formers can be "planked" or sheet covered with thin strips or sheets of balsa. Similar to this is the method of semi-prefabricated construction now used for flying-



The 34-in. Veron Cirro-Sonic, a well-produced kit which builds up into a simple but high-performance glider.

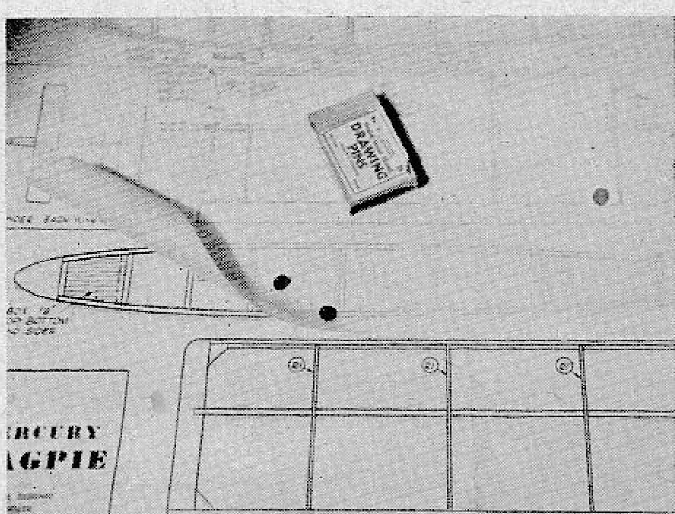


Fig. 1. Cover plans with translucent waxed paper to prevent frames adhering to them.

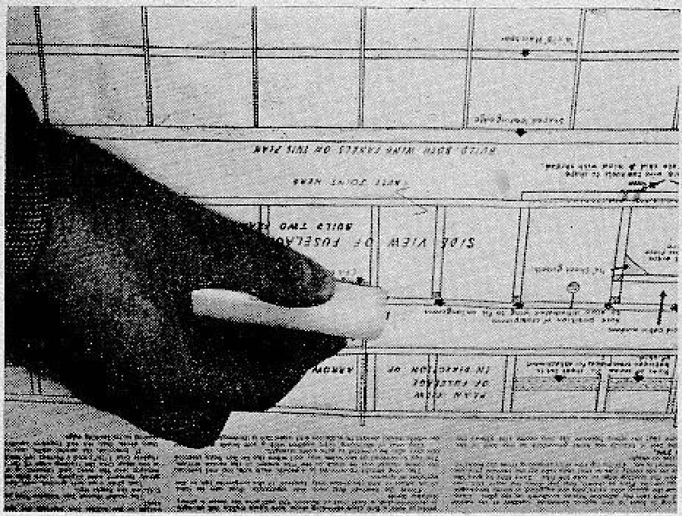


Fig. 2. An alternative method to Fig. 1 is to rub the drawing with candle wax or soap.

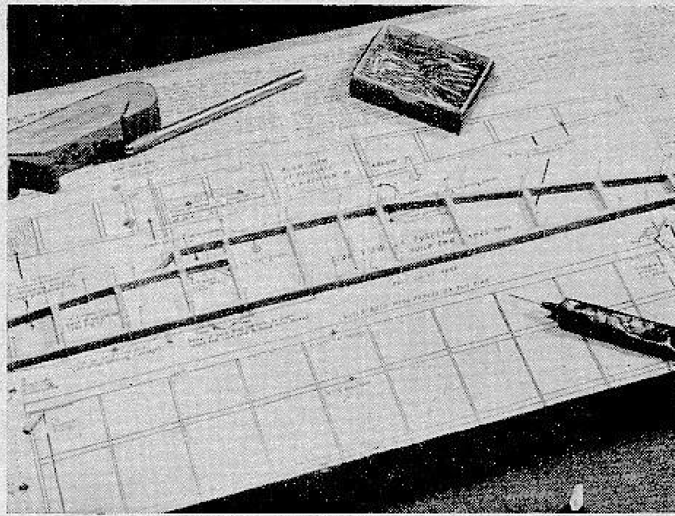


Fig. 4. After fitting the spacers, the second side of the fuselage is built over the first.

scale models by some British and American kit manufacturers, in which moulded sheet balsa shells form complete fuselage sides. For some types of C/L models, hollowed block balsa is used.

As we have said, there are countless different types of fuselage structures, all using balsa. The variety is even further expanded when we take into account the metals and glass-fibre-plastics used by some designers.

In this chapter on basic fuselage construction we have chosen the simple built-up box frame for our photographic sequence for two main reasons. Firstly, as we have said, it is the type of structure most commonly encountered by the model builder. Secondly, while we are admittedly concerned at this stage with your first model, which should obviously be a simple one, no very useful purpose would be served by devoting our space to a profile or similar ultra-simple fuselage since our main object is to equip the reader with sufficient knowledge to enable him to tackle, eventually, the more advanced models that may appeal to him.

Building a Box-frame Fuselage

Our photograph sequence is based on a typical beginners' built-up glider of orthodox design, the 30-in. span Jasco *Tutor*. Representing good value at only 6s. 5d., the kit contains all necessary materials, including cement and tissue.

As with all fuselage structures of this type, the two sides are first built and then joined together with the top and bottom cross members. The sides are built by pinning the wood strips to the side view of the drawing of the fuselage, the drawing being secured on a flat surface.

The first requirement, therefore, is a building board (unless you have a bench or table top into which it is in order to knock pins). The most suitable material for a building surface is a piece of well-seasoned, planed softwood, such as pine, which is free from warps and is at least ½ in. thick and preferably ¾ to 1 in. A piece 8 or 9 in. wide and 3 ft. long will suffice for all but the largest models.

Fix the drawing to the board with drawing pins or cellulose tape. Leave an area of the board exposed for a cutting surface (to avoid slicing holes in the plan with your modelling knife or razor blade) or, better still, have a piece of cardboard handy for this purpose. Don't use hardwood as this will soon dull the edge of your tools.

To prevent the frame sides sticking to the drawing where the cemented joints are made, it should be pro-

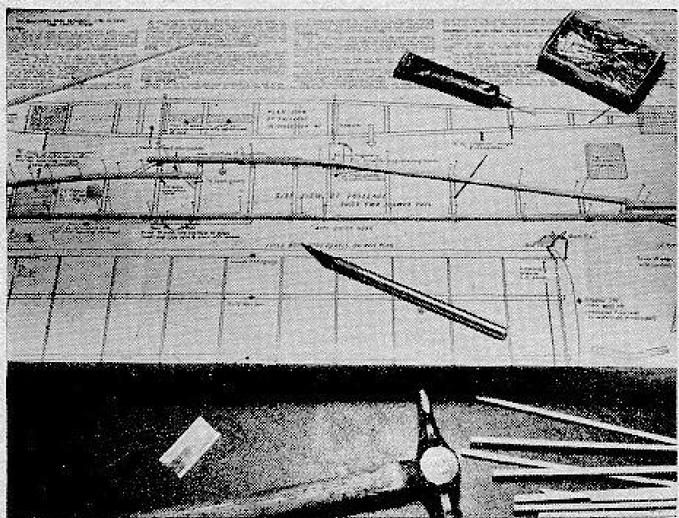


Fig. 3. Position the longerons on the drawing with pins either side of the strips.

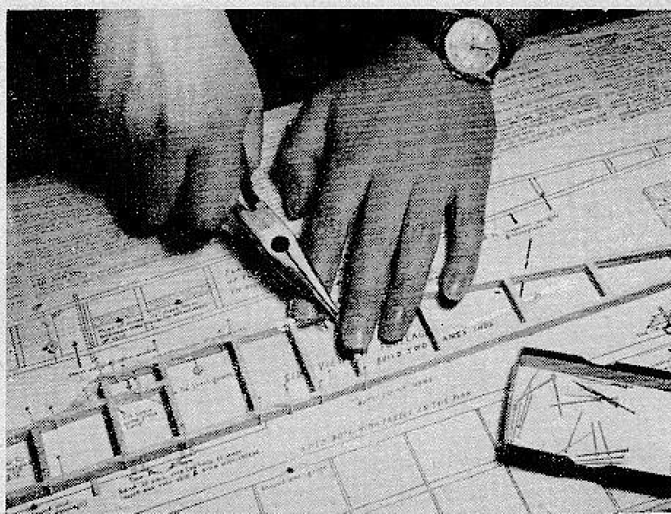


Fig. 5. Hold the structure down firmly when removing the pins from the building board.

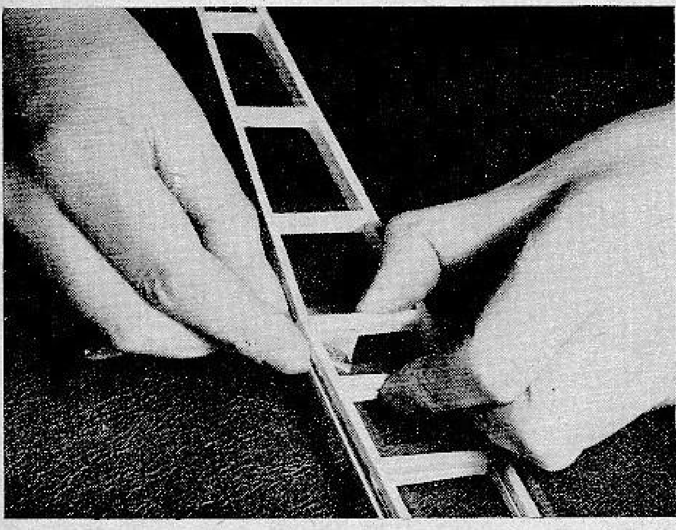


Fig. 6. The two fuselage sides should be carefully parted with a razor blade.

tected with a sheet of translucent waxed paper over the section on which you are working. (Fig. 1.) Alternatively, a thin protective film can be rubbed on the drawing at these points with a candle (Fig. 2) or a piece of soap.

In most kits there is some variation in the hardness of the balsa strips supplied. Before starting the construction, therefore, sort out the fuselage strips, selecting the harder material for the longerons and front spacers and setting aside the softer material for the tail end. Try to select strips of equal flexibility for the longerons, as this helps to make for accuracy of alignment. Hardness and flexibility can be tested by finger-nail pressure, and by holding the strips at one end and gently waving them up and down to observe their bending tendencies. (Although these methods may seem to be somewhat "rule of thumb," they do with practice become quite reliable methods of selection.)

Another thing to watch is that the strips are of equal thickness, for, although $\frac{1}{8}$ in. sq. strip should, of course, by $\frac{1}{8}$ in. $\times$ $\frac{1}{8}$ in., this is not always the case; there can be fractional differences between the dimensions of nominally identical sizes. Small differences of this nature, although unimportant individually, tend to build up into larger errors in the final assembly.

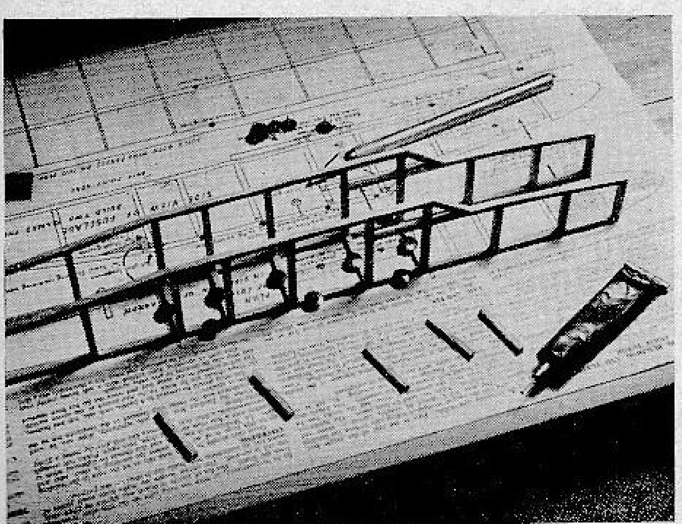


Fig. 7. Erecting the fuselage sides vertically on the plan view and inserting the spacers.

The method of setting the longerons on the plan is to position them with pins either side of each strip. (Fig. 3.) Ordinary 1 in. plated household pins, which can be knocked in with a small tack hammer, or special bead-head modelling pins can be used. Pins should be used on the outside of the longeron at each spacer station as well as where bends occur. Place the inside pins near to the positions of the outside ones where the longerons are straight, in order to avoid any risk of distorting them.

Longerons can usually be bent to conform with mild curves, but if any difficulty is experienced with more acute bends, they should be pre-formed by steaming. Take the two longerons, bind them lightly together with cotton and steam them over a kettle, gently bending the curves where needed.

Fuselage spacers are invariably butt-jointed to the longerons and should be cut in pairs so that an identical set is available for the second side. For the actual cutting, there is nothing better than the ordinary steel-backed single-edged razor blade. The accepted method is to hold a length of strip across the longerons in the required position for the spacer and make shallow preliminary cuts with the razor blade held at the desired angle, then

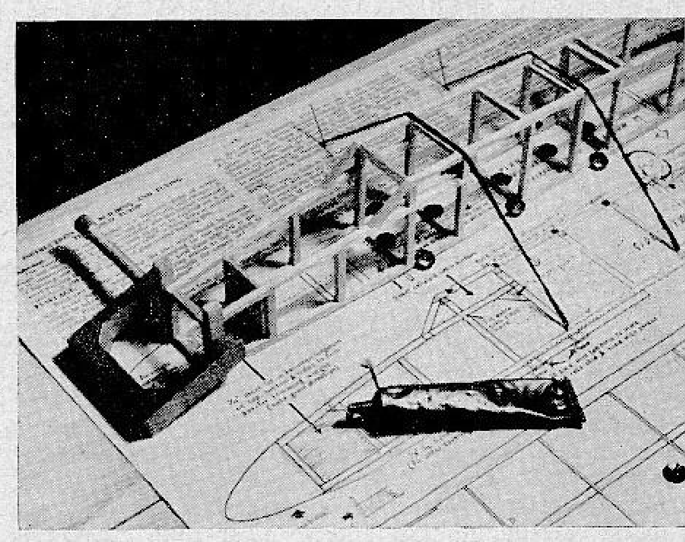


Fig. 8. Using rubber bands to assist alignment and an X-acto clamp to hold the nose section.

to slice through vertically on your cutting surface. After checking the fit of the new spacer, a duplicate is cut, using it as a pattern.

In making a butt joint, particularly where (as in the case of spacers to longerons) end-grain surface is involved, the surfaces should always, in the interests of strength, be "pre-cemented"—i.e. a coating of cement should first be applied and allowed to dry before applying a second coat and fitting the parts together. Make sure that the spacers are inserted squarely and flush with the longerons.

When the fuselage side has been completed, do not remove it or the pins from the plan but, instead, build a second side on top of it. Make sure the pins are secure and vertical and then insert the longerons of the second side. Here you may either insert small scraps of waxed paper between the sides, where the spacer joints occur, to prevent their sticking together, or you may omit these and slit the sides apart afterwards with a razor blade as in Fig. 6.

When both panels are completed, leave them pinned down to the board for half an hour or so, in order to let

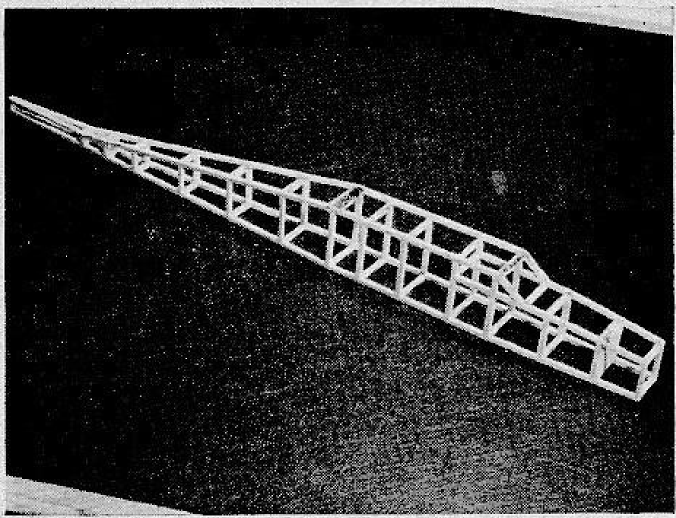


Fig. 9. The basic framework removed from plan when dry.

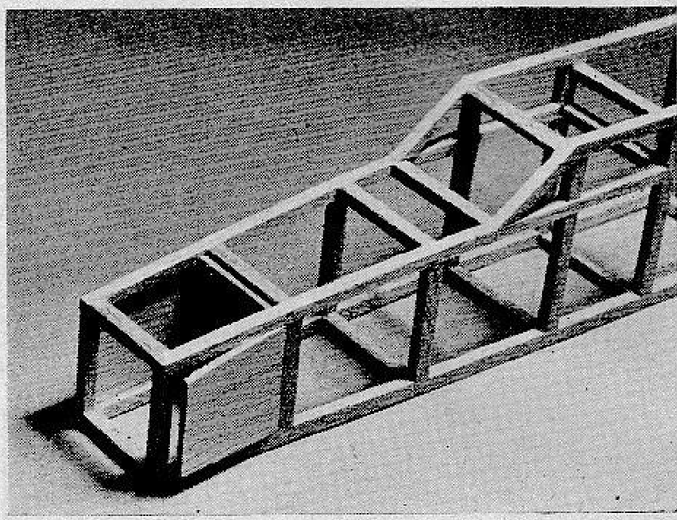


Fig. 10. Fitting the sheet balsa fill-in panels to the nose section

the whole assembly set hard. Meanwhile, the upper and lower spacers may be cut, using the plan view of the fuselage to obtain the correct lengths. When the fuselage sides are ready to be removed from the plan, first withdraw all the pins with a pair of pliers, placing a finger on each side of the longeron to avoid risk of lifting and damaging joints. (Fig. 5.) The next stage is important and it is advisable to constantly check for accuracy.

First erect the sides vertically on the plan using drawing pins, as in Fig. 7, and cement the widest bottom spacers in position. You can, if you prefer, erect one side only and cement the spacers to this side before adding the second side. Now drive two pins into the building board at an angle, 2 or 3 in. either side of the fuselage as shown in Fig. 8. Insert at least two of the top spacers at this position and then stretch two long rubber bands across the fuselage and over the angled pins.

By carefully adjusting the tension of the rubber bands on each side, it will now be possible, with the aid of a set-square, to get the two sides absolutely upright and true. Use plenty of cement around the joints at this time.

Now cement the tail end together and insert the remaining spacers, working towards the tail. The nose section is left till last, being usually the most tricky part, because it has to be drawn in more sharply, and so the rest of the structure is stiffened up as much as possible first. When cementing in the nose spacers (sometimes a sheet balsa former or bulkhead is fitted, too) it is helpful to have a clamp to hold the sides in while the cement dries. An "X-acto" clamp is handy here, Fig. 8.

Once again, allow the joints to set hard before removing the structure from the plan and, before removing it, sight through the fuselage to make sure that all cross members are in line. If any of them should be out of alignment, the joints can be sliced through with a thin razor blade and recemented. It is a good idea at this stage, incidentally, to add a minute fillet of cement in each right angle formed by the spacers and longerons.

Quite often the front bay of a rectangular section fuselage is boxed in for added strength and/or to provide a ballast weight compartment. Fig. 10 shows how to do this, the sheet balsa being accurately cut to fit flush.

Finally, the noseblock can be fitted. First lightly cement the block in position and mark the required outlines with a ball pen or soft pencil. (Fig. 11.) The block can then be roughly sawn or carved, then re-cemented in position and sandpapered to the precise shape. A sandpaper block, such as the "X-acto" illustrated (Fig. 12), or one improvised from a small block of wood, is necessary here.

Fig. 11. Marking the noseblock, which is then roughly sawn or carved to shape.

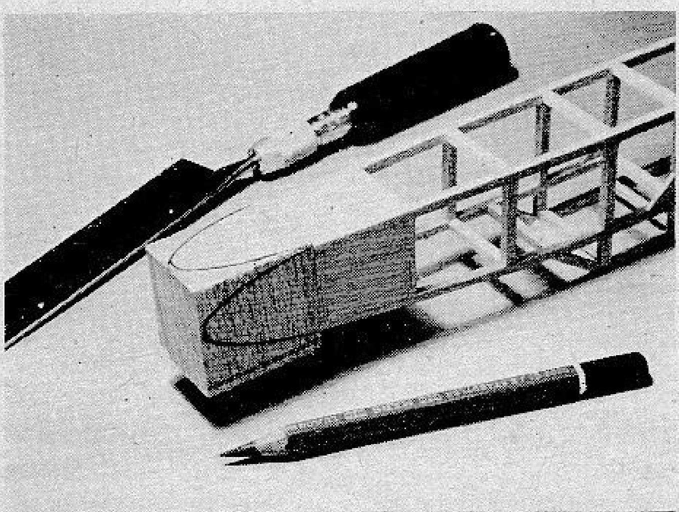
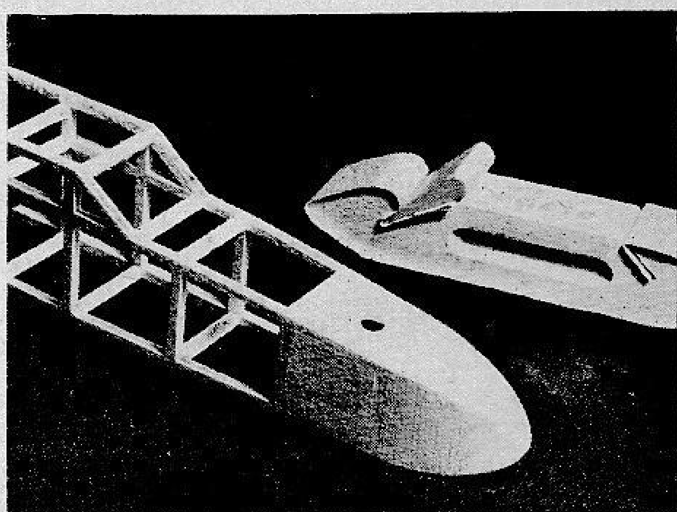
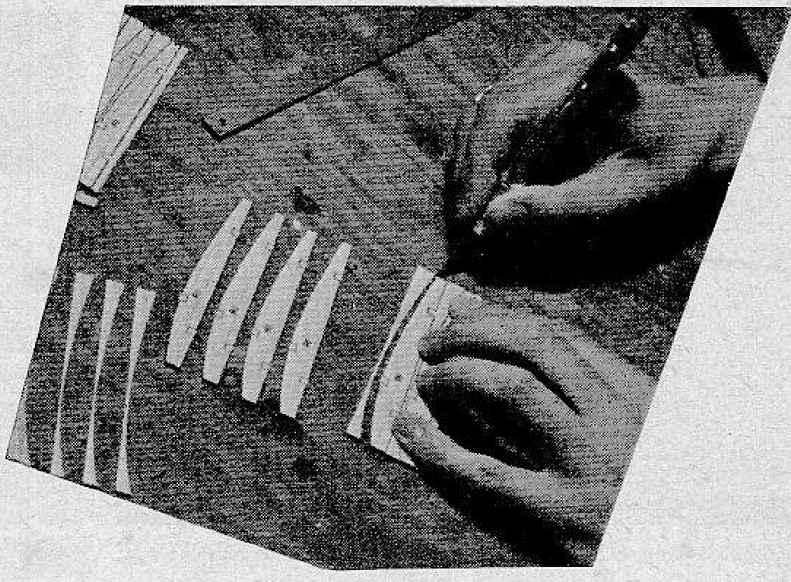


Fig. 12. Final shaping is effected with a sanding block. Hole is for lead shot ballast.



Building the wings and tail



ONE of the essentials of a beginner's model is a robust and easily constructed wing and tail unit design. Another is that the wing and tail are built accurately. A model will never perform satisfactorily with warped flying surfaces. Therefore, having chosen a model design with a simple but strong framework, every effort should be made to assemble it carefully and accurately.

CHAPTER FIVE

It would be a mistake to suggest that any one part of a model aeroplane requires less care and attention than another, but one of the reasons for beginning your first model with the fuselage is that it gives you the initial experience in simple assembly procedure which is of especial value when constructing the wing and tail. The fuselage must be as well built as you can possibly make it, as it is the component to which all the other parts of the model are attached. Having done this, redouble your efforts to make a good job of the flying surfaces.

As with the previous chapter on fuselage construction, the photograph sequence is based mainly on the Jasco *Tutor* beginner's glider which is of 30 in. wing span.

The first thing to do is to prepare the wing ribs. When building from a kit, the ribs will be supplied in one of three forms. Firstly, they may be printed on sheets of balsa wood, thus requiring to be cut out with a razor blade or modelling knife. Alternatively, instead of being printed, the sheets may be die-cut, requiring only that the ribs be pressed out (although possibly requiring to be released, here and there, by application of the model knife) or, thirdly, the ribs may be supplied ready made and finished.

One of the first requirements of accurate wing construction is that all ribs should be absolutely identical. This does not merely apply to the outline shape. Just as important, if not more so, is that they are all exactly the same length (assuming the wing to be of the parallel chord type) and that the positions of the spar slots are the same on all ribs.

In some kits having printed or diecut stock, the ribs are positioned exactly one above the other on the sheets. In this case, you can make sure that the lengths of the

Fig. 1. Using a chisel-point knife for cutting spar slots in ribs.

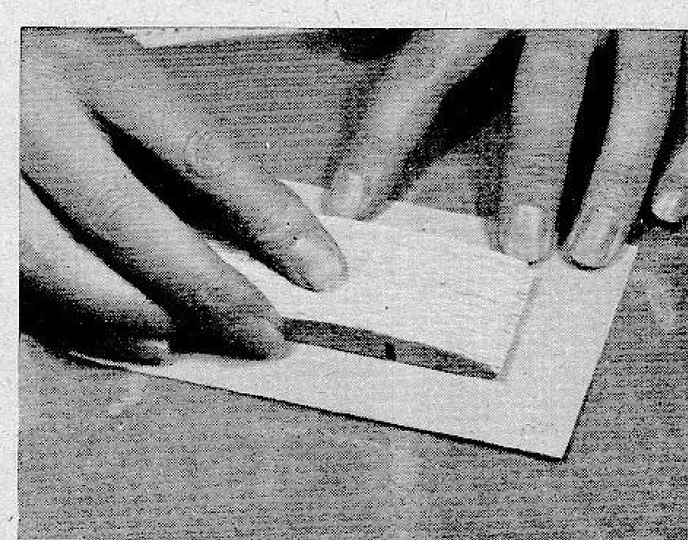


Fig. 2. Smoothing down a block of ribs on a sheet of sandpaper.

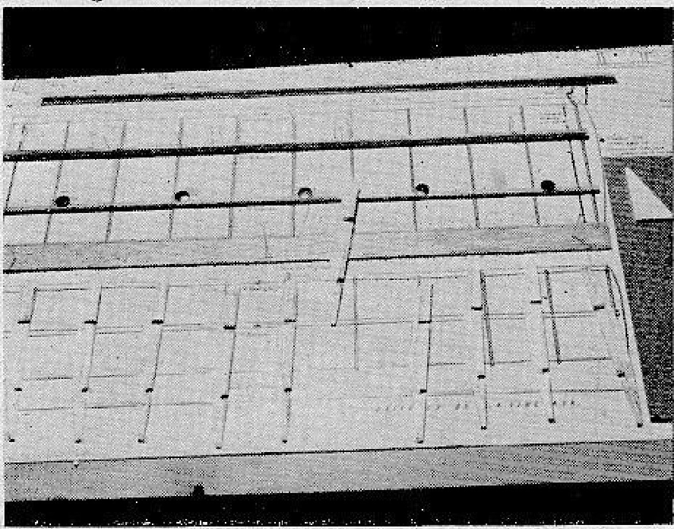


Fig. 3. Laying out the spars on the plan, ready to receive the ribs.

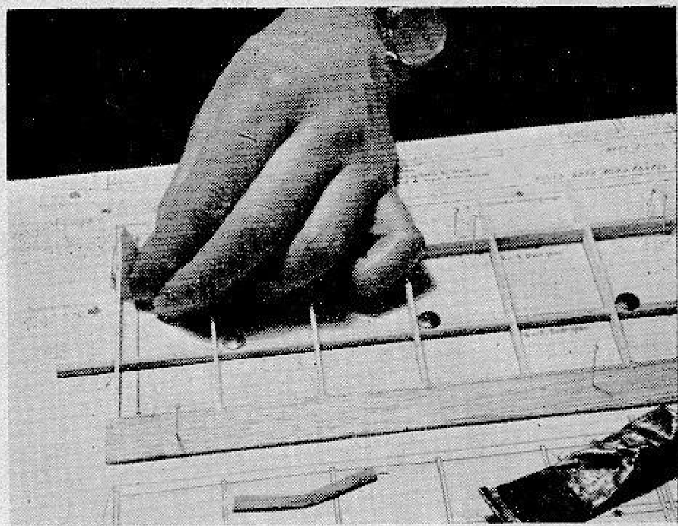


Fig. 4. Using a sheet balsa template to align the centre section rib.

ribs are identical by slicing straight across the sheets against the grain, with the aid of a straight-edge. Use the straight-edge, too, when cutting the flat bottom surface although the cambered top must be cut free-hand.

Spar slots on printed wood can be cut in two ways. If you are satisfied that they are marked accurately, they can be cut individually as in Fig. 1. Here it is useful to have a chisel-point blade in your knife, such as the "X-acto" No. 17 blade.

Alternatively, all the ribs can be pinned together in a block and the spar slots made by cutting them *en masse*, preferably with a razor saw. In any case, it is a good idea to pin the ribs together for final shaping (especially if the die-cutting is not very clean) so that they can be smoothed down on a level surface (see Fig. 2). Where ribs are supplied ready finished, this is not, of course, necessary.

As in the case of the fuselage, the drawing is pinned or taped down to your building board. Incidentally, make sure that the drawing is pulled out flat in order to avoid any wrinkles or ridges that would prevent the framework from lying perfectly flat. The same applies to the waxed paper covering if you should use this method of protecting the plan instead of rubbing with candle wax or soap. It is usual, with most models, to build the wing in two halves, which are then joined at the centre section after assembly.

Position the centre spars on the plan with pins either side of the wood and check the fit of the ribs on them. The slots should be a close but easy fit. (If the fit of the ribs is excessively tight—especially if the spar is a deep one —there is a danger of the ribs being bowed upward when removed from the plan. Alternatively, if the slots are too big there is a danger of the cement causing the gap to shrink so that the ribs will tend to be bowed downward. Do not omit to check, also, the fit of the leading edge spar against the nose of the ribs.

With some wing designs, the ribs are let into slots in the trailing edge spars. If this should be the case, the trailing edge should first be marked and slotted (a small file is useful here, although a steel backed razor blade can be used) and then pinned in position on the plan. Incidentally, it is quite permissible to pin *through* the wood in the case of trailing edge stock as it is wide and will not split easily (Fig. 3).

The next step is to position the ribs on the spars as indicated on the drawing. Pre-cement them and then cement each in position securely, making sure that it is upright and that it is well pressed down so as to make contact, all along its bottom edge, with the building board.

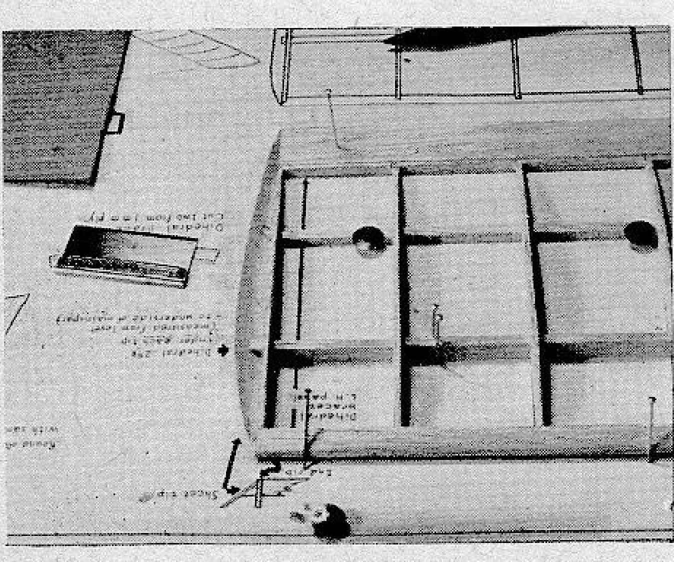


Fig. 5. After fitting the leading-edge spar, the wing-tip is fitted.

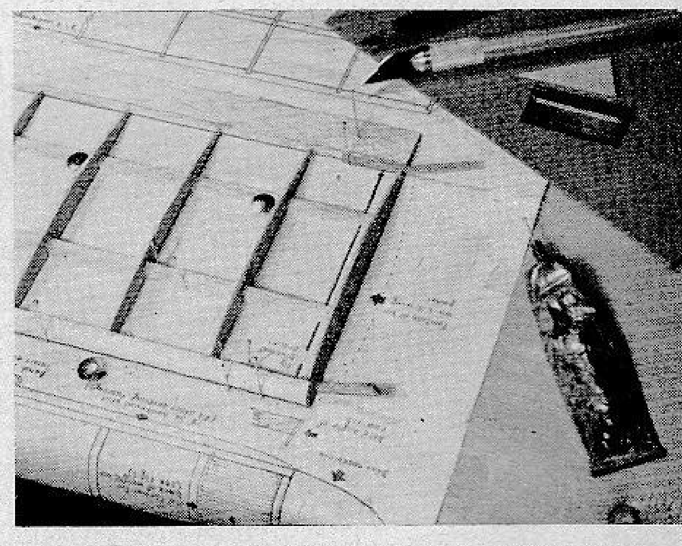


Fig. 6. Fitting the dihedral keepers which join the wings.

Usually, root or centre section ribs are inclined slightly so as to be vertical when the wing panels are raised to the correct dihedral angle. Therefore, it is a good idea to make a simple sheet balsa template against which the rib can be tilted to give the correct slope, as in Fig. 4.

When all the ribs are in position, the leading edge spar may be fitted. Many kits nowadays contain ready shaped leading edges. In others a square (usually set on edge) or oblong section spar is used. In the latter event, the strip may be roughly rounded off before fitting, but it is more usual to leave this until the wing is completed and has been removed from the plan, when the leading edge can be carefully shaped up with a sanding block as in Fig. 9 (Mercury *Magpie* model).

Wing tip construction is in various forms and the inclined sheet balsa type tip as shown is only one of many. In general, however, this blunt type of wing tip is more widely favoured, especially for elementary models, due to its greater strength and simplicity. The sheet tip should be finally shaped up with a sanding block after fitting.

Some means of connecting the two wing halves together and at the correct dihedral angle is, of course,

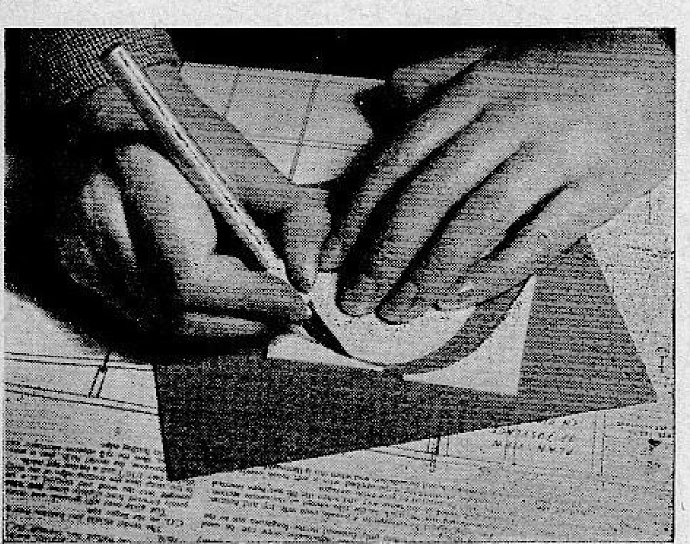


Fig. 8. Cutting out the tail fin and rudder from $\frac{1}{16}$ in. sheet balsa.

necessary. On some small models, the two panels are merely butt jointed at the centre with plenty of cement. Usually, however, it is necessary, in the interests of strength and accuracy, to connect them by means of dihedral braces or "keepers," which are shallow V-shaped plates of plywood (sometimes balsa on light models). These go through the centre ribs and are cemented against the spars. Fig. 6 shows how these are attached to one panel of the *Tutor* wing.

When both wing panels have been built, it is a good idea to leave them pinned down to the building board for as long as possible, or for at least half an hour following the completion of the second panel. The first half wing should be set by this time and can be removed from the plan ready for joining to the second panel, which can be left pinned down. Cut away the root rib where necessary in order to accommodate the dihedral keepers and slip the first half into position. With the aid of blocks or books, support the wing so that the tip is raised by the requisite amount (i.e. twice the tip rise specified for each wing). This can be checked by means of a set-square or ruler.

Now remove the panel again and pre-cement all contacting surfaces. When dry apply more cement and

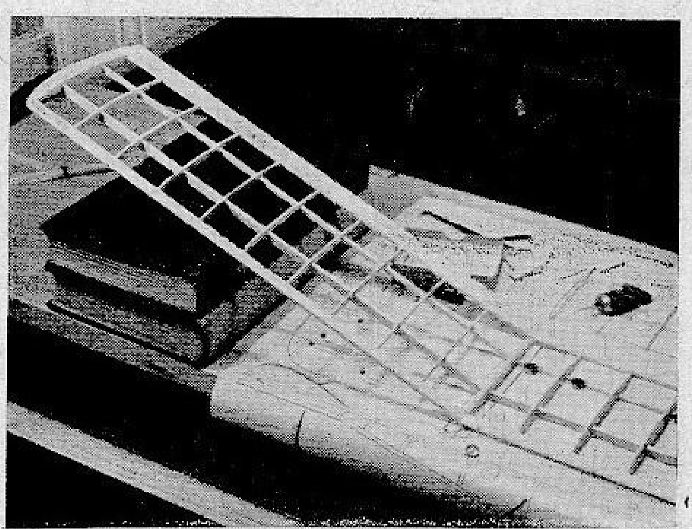


Fig. 7. The two wing halves joined and set up at the correct dihedral angle.

set up in position as before, using pins to ensure even contact between the surfaces joined together. Check dihedral again and also check to see that one wing is not twisted in relation to the other. Do not be afraid of using cement fairly liberally at this point. Then set the whole assembly aside for at least two hours (Fig. 7).

The various tail unit parts such as the fin and rudder (Fig. 8) and tailplane ribs, can now be cut out. On the *Tutor*, as on many models of this type, a sheet balsa fin is used. It has a simple trim tab or rudder which is attached to the fin by means of simple "hinges." These hinges are merely pieces of thin aluminium about $\frac{1}{4}$ in. long × $\frac{3}{16}$ in. wide which are inserted into the adjacent edges of the fin and rudder and allow the latter to be bent to the left or right (Fig. 10). A preliminary cut should be made with a piece of broken razor blade and the "hinge" inserted with cement. Material for the hinges is not included in the kit and something a little stronger than the aluminium bottle caps suggested by the manufacturers is to be preferred. In the absence of suitable thin metal, soft copper or iron wire (such as florist's wire) may be used.

The tailplane is constructed in much the same way as the wing and needs little comment. Make sure that the

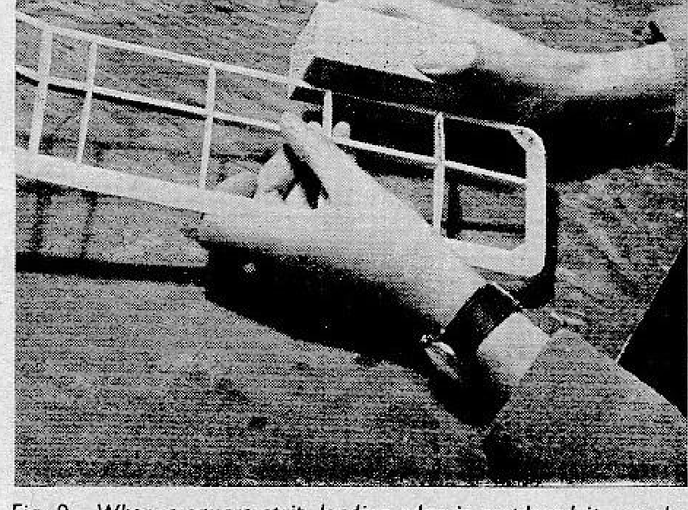


Fig. 9. When a square strip leading edge is employed it may be shaped with a sanding-block.

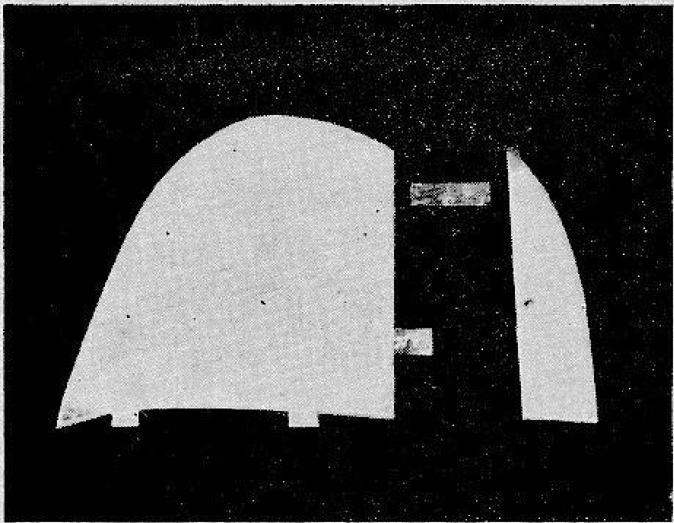


Fig. 10. The rudder is " hinged " to the fin with thin strips of soft metal.

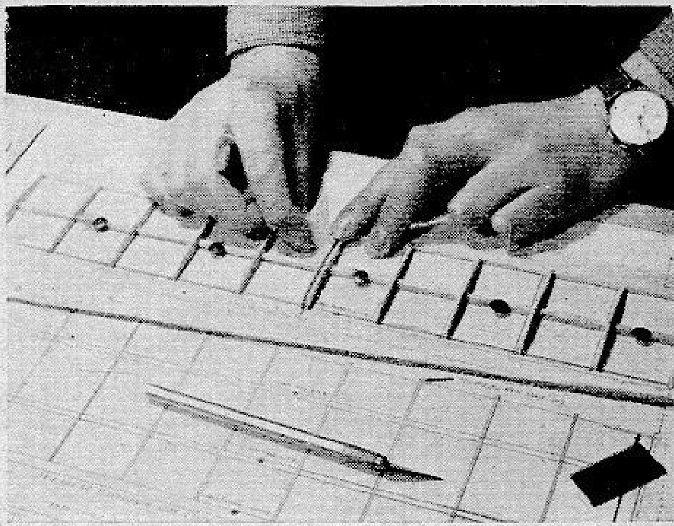


Fig. 11. Aligning the tailplane centre-ribs to ensure accurate positioning of the fin.

two centre ribs are spaced accurately to receive the fin and ensure that they are perfectly vertical so that the fin, when subsequently fitted, is held perpendicular to the tailplane. To make sure of this, cut a right-angled template from scrap balsa sheet, against which each rib can be aligned (Fig. 11).

This completes the assembly of the wing and tail surfaces (Figs. 12 and 13). They may now be gently sandpapered all over in order to remove any slight roughness and to prepare them for covering.

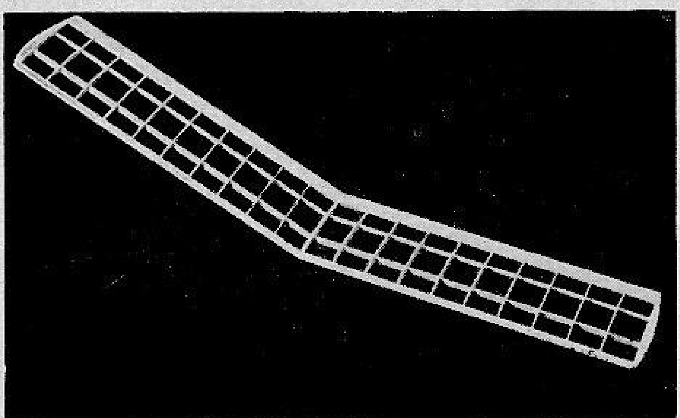
The majority of model wings employ sheet balsa ribs, with shaped strip balsa leading and trailing edges and rectangular section supplementary spars, as in our beginner's model. However, differences will be found in other types, notably in the spacing of the ribs, the type, number and positioning of the spars, the wing tip design and the type of dihedral. For example, on larger and heavier models where stresses are greater, ribs become more closely spaced and spar depths are increased to carry greater bending loads. Sometimes the leading edge portion of the wing, extending back about one-quarter of the chord, is covered with sheet balsa which, if properly used, can result in a substantial increase in resistance to vertical bending loads as well as increasing torsional stiffness.

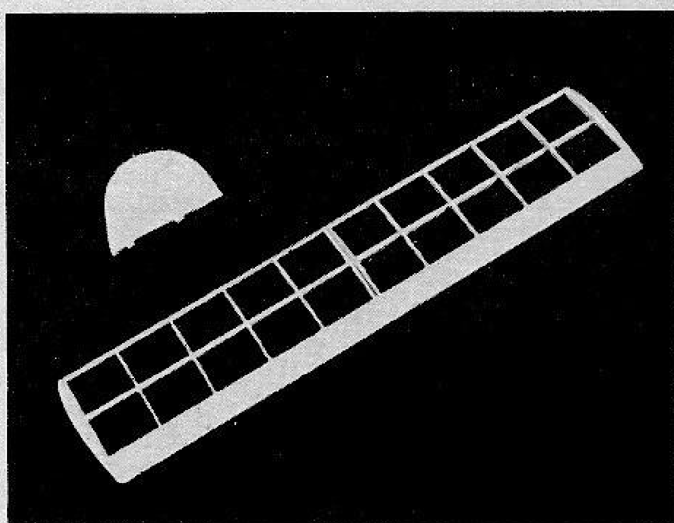
Another type of structure having considerable strength is that featured by some large R/C models and C/L types in which flat spars are let into the top and bottom surfaces of a wing, one immediately above the other, and are then webbed or boxed between the ribs so that the complete spar actually extends to the full depth of the wing section. When this is combined with the sheeted leading edge previously mentioned, so that, in effect, the nose section of the wing forms a complete hollow spar in itself, very great strength and rigidity can result.

In former years, spars (sometimes of box- or I-section) passing *through* the ribs (i.e. not let in either from top or bottom) were favoured in some quarters, because they avoided the slight ridge in the covering which a spar that is flush with the ribs on a curved upper surface will cause. However, modern high performance models have shown the need for strong and rigid wing construction, so that this theoretical aerodynamic advantage is considered less important than the improved structural design otherwise made possible.

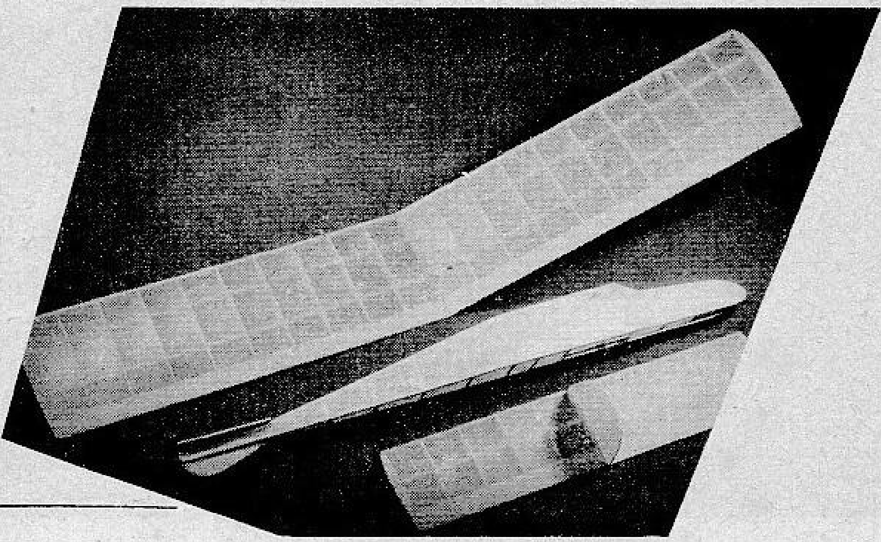
The choice of suitable grades of materials for the wing and tail is important if a serviceable model is required. In general, medium-hard, straight-grained balsa is desirable for the spars. If a thin, square-sectioned leading edge is used, for example, this should be fairly hard to resist breakage. If the leading edge is of thicker section, however, and the ribs are more closely spaced, a medium grade is permissible.

Fig. 12 (below). The completed Jasco " Tutor " wing has a span of 30 in. Fig. 13 (right). The completed tail unit. The fin fits between the centre ribs of the tailplane after covering.





Covering and Doping



CHAPTER SIX

IN scarcely any field of human endeavour does one expect to start off by doing a new and strange job perfectly, at the very first try, and the hobby of building and flying model aircraft is no exception to this rule.

Perhaps, so far, you have made a good job of the framework of your model and are duly encouraged and ready for the last stage: covering and doping. In this case, let us add a warning not to relax your efforts to make an equally good job of the final stage. Covering a model really well at the first try is not an easy matter, and the fact that the model is now nearly finished should be accepted as an added incentive to take extra care, rather than as an encouragement to rush through the job in order to see what it looks like.

When you have built two or three models you will find that covering a model neatly is quite a simple and straightforward business. If your first attempt does not turn out to your liking *don't*, therefore, be discouraged. Most of us were by no means satisfied with our first attempts, but if you persevere you will soon find yourself producing neat and satisfactory jobs.

Fortunately, nowadays, we are aided in our efforts by the availability of covering materials with which it is much easier to make a good job, than with those used in earlier years. Modelspan and Silkspan covering tissues are easier to apply and generally shrink evenly over the framework with a single coat of dope. In the past, preliminary water shrinking was necessary and, due to a pronounced "grain" formation, tightening occurred very much more in one direction than in the other.

These improved covering materials are sold in a variety of colours, although white only is included in most kits and it is therefore worthwhile to consider spending a few pence on obtaining fresh tissue for the desired colour scheme. A most effective colour scheme, incidentally, is yellow and red; yellow being for the fuselage and red for the wing and tailplane.

This scheme has the advantage that the red flying surfaces can be most clearly seen when the model is well up overhead, while the light coloured body enables it to be seen against a dark background if the model should drift

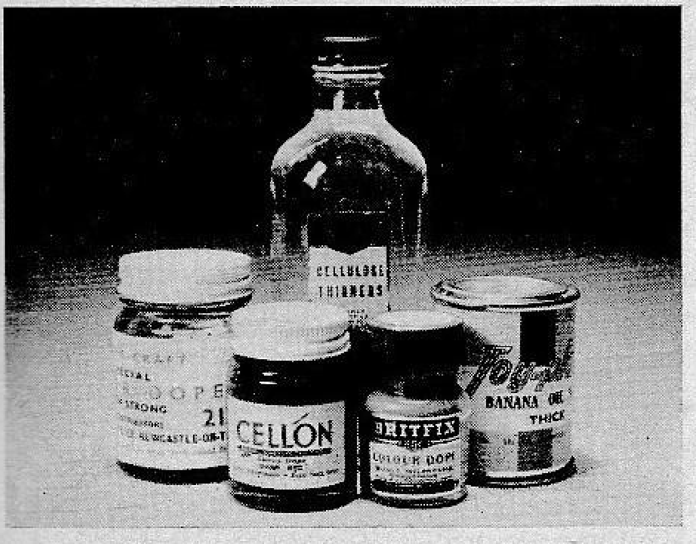


Fig. 1. A selection of dopes. Shrinking dope, thinners, banana-oil and coloured dopes.

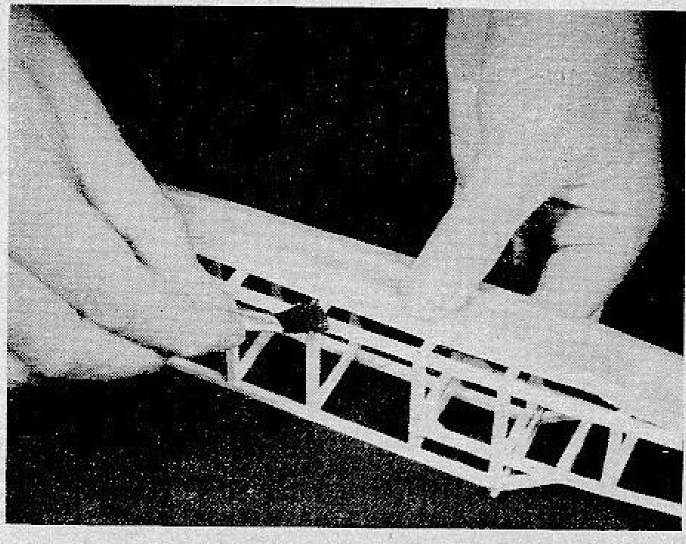


Fig. 2. Apply adhesive to the longerons after attaching the covering to the nose and tail.

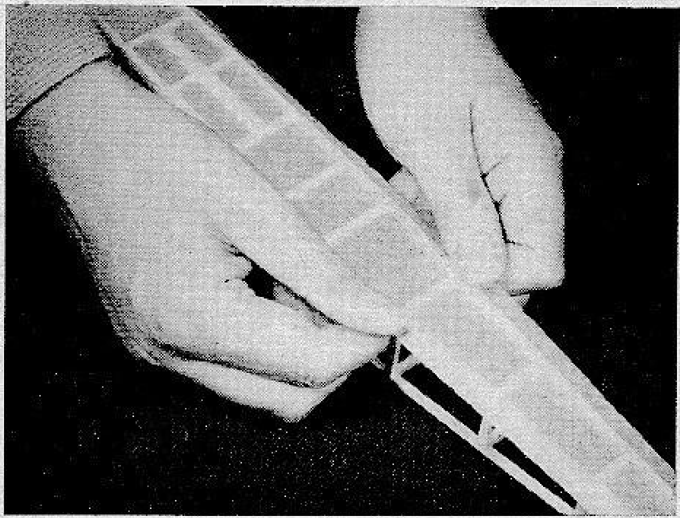


Fig. 3. Drawing the tissue down onto the longerons with a steady even pressure on both sides.

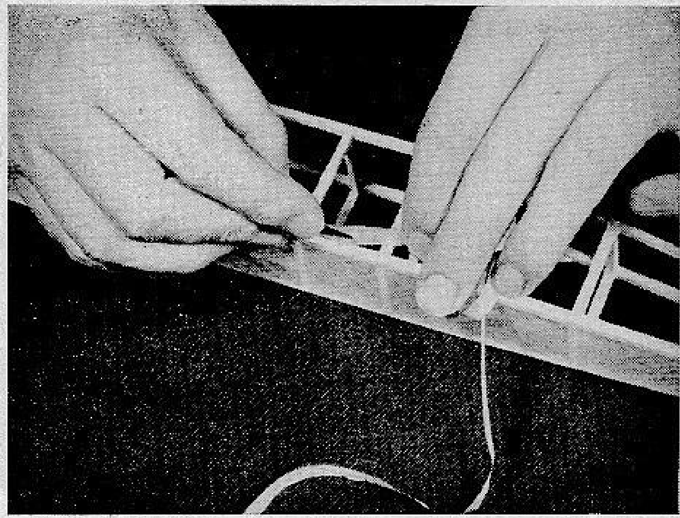


Fig. 4. Trimming the tissue, leaving a small overlap, which can be doped down afterwards to seal the edges.

a fair distance before landing. (If, at this stage, we appear to be unduly optimistic about the long-flying qualities of our finished model, it is worthwhile remembering that, during the summer months, even a model of quite modest performance may easily have its flight extended by a thermal up-current, and so it is as well to be prepared.)

In addition to the covering tissue, you will also require some adhesive, dope and brush. Various types of adhesive are used for covering. Most American modellers, for example, use ordinary model dope which has been thickened with balsa cement. Many British builders, on the other hand, use a hard dextrine paste, of the "Grip-fix," "Dex" or "Kodak" type and we would suggest this latter as being more suitable to the beginner as it does not dry quite so rapidly and thus allows more time to get the covering positioned properly.

The dope required is of the clear, shrinking dope type and a 2-oz. bottle will be ample for our needs. You can obtain ready thinned "model" dope, or a "full-strength" dope. In any case, however, it is worthwhile to buy a bottle of cellulose thinners with which to dilute the dope to a reasonable brushing consistency and to clean your brushes. As regards brushes, a ½ in. wide soft brush, obtainable at a model shop, is all that is required, plus a small, cheap artists' brush for sealing the edges of the tissue when covering. You may, of course, use a super-soft sable doping brush if you wish, but these, generally, can be reserved for applying coloured cellulose lacquers for decorative purposes, which need not concern us at the moment.

Before starting on the actual covering, it is advisable to go over the framework with a sandpaper block to smooth out any roughness and to remove any blobs of dried cement, etc. At the same time, check all joints to see whether any have become broken and, if so, carefully cement them up again. It does not greatly matter which part of the model is covered first, but we suggest either the tailplane or fuselage so that if you are dissatisfied with your initial attempt at applying the covering, it is not too much trouble to strip it off and repeat the process and very little material will have been wasted. Let us assume that the fuselage is to be covered, starting with the bottom.

Clear your work table, giving yourself plenty of elbow room. Lay out the various items you will need: tissue, adhesive, small artists' brush and a new razor blade or *sharp* modelling knife. (Generally, a razor blade is to be preferred, but we have found that an X-acto blade, such

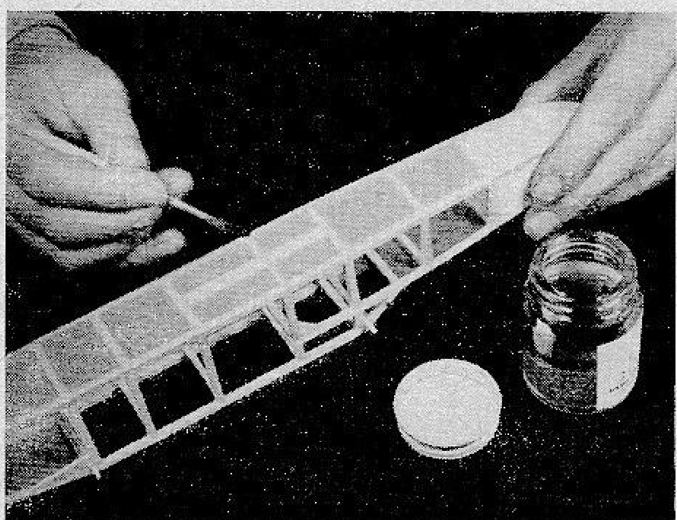


Fig. 5. Sealing the edges of the tissue with dope.

Fig. 6. When newly doped, the covering goes slack, as shown.

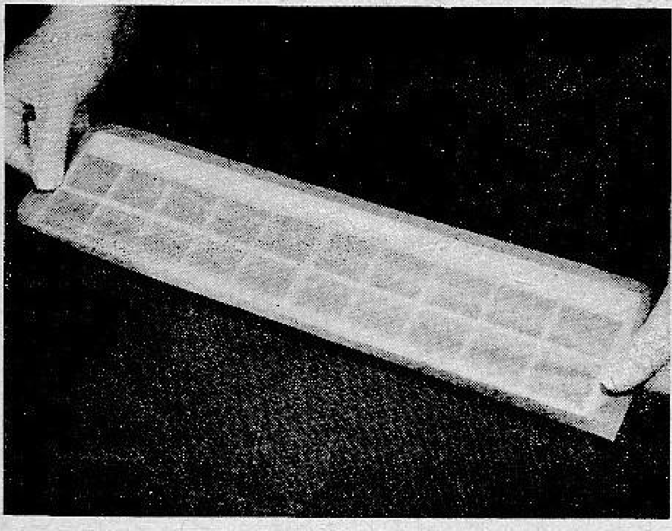


Fig. 7. The first stage in covering a tailplane.

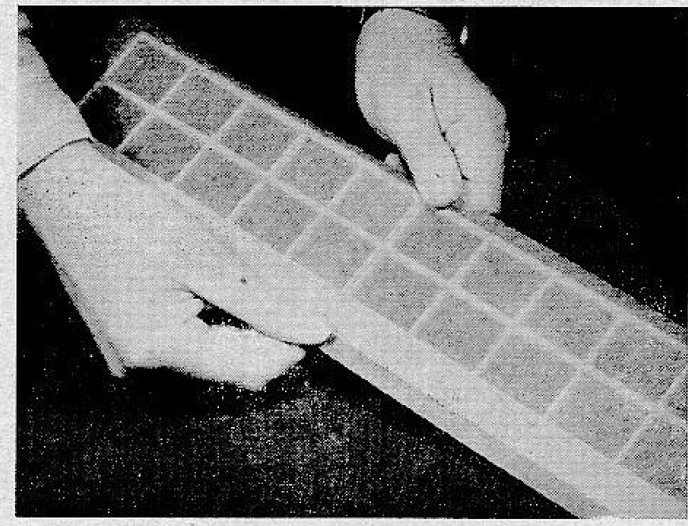


Fig. 8. Second stage: stretching across the chord at the centre.

as the straight edged No. 11, is also satisfactory.)

First cut a piece of tissue to the required size, allowing about ½ in. overlap all round. Apply paste to the nose and tail of the fuselage. Take up the tissue, holding it lengthwise and lay it squarely on the bottom of the fuselage, stretching it from nose to tail and gently pressing it down on the pasted wood.

Now, with the edge of the tissue folded back, apply paste along the two longerons, as in Fig. 2. (You could, of course, have applied the paste all over the framework in the first place. The only reason for doing the pasting in two stages is to simplify matters and avoid the possibility of the tissue adhering to the longerons before being properly positioned.)

Gently stretch the tissue across the fuselage at the centre (Fig. 3) then work towards the nose and tail, carefully working out the wrinkles. Set the work aside for a few minutes, then, with the fuselage on its side, and the surplus tissue drawn around the longeron, carefully trim off, as in Fig. 4, so that a margin about 3/32 in. wide is left which can be doped down onto the longeron. This latter operation can be performed with the small brush and some unthinned dope.

Cover the top in the same manner. Usually it is unnecessary to cover that section of the fuselage upon which the wing rests. The side panels complete the job. Once again, a small overlap should be left after trimming, which is sealed down with dope, as before. (Fig. 5.)

The entire unit can now be doped. Do not attempt to use dope which is too thick. It is better, and just as economical, to dilute with cellulose thinners and to apply two coats rather than one thick coat. The pores of the tissue will then be more evenly filled and the finished apearance will be better. As the surface of the tissue is doped, it will take on a translucent appearance, and will slacken (Fig. 6). After it has dried, however (about half an hour), it will become drum tight, adding considerable rigidity to the component.

Let us now go over the procedure, briefly, once again; this time referring to the covering of the wing and tail surfaces. The tailplane can be covered with two pieces of tissue; one on each of the two surfaces, top and bottom. The wing is best covered with four pieces; top and bottom, left and right.

Fig. 7. (Tailplane.) Paste the bottom of the framework. (Trailing edge first, as this has the greatest area and allows the longest time for the paste to dry, followed by the tips and the leading edge last.) Lay the tissue out

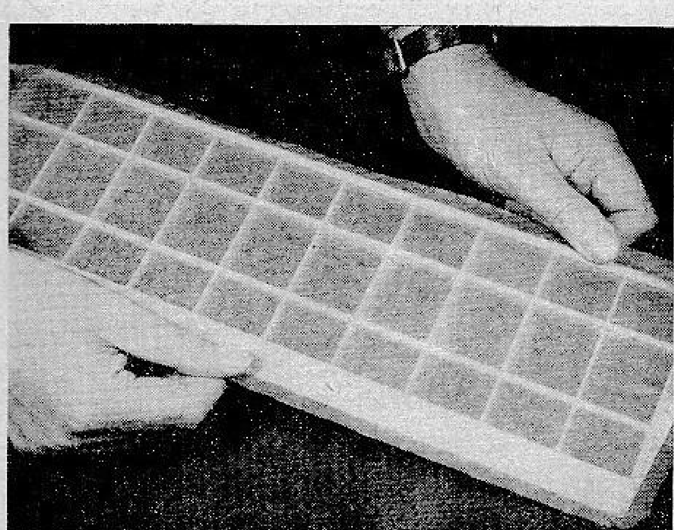


Fig. 9. Third stage (this time shown on wing). Drawing out the tissue towards the tips.

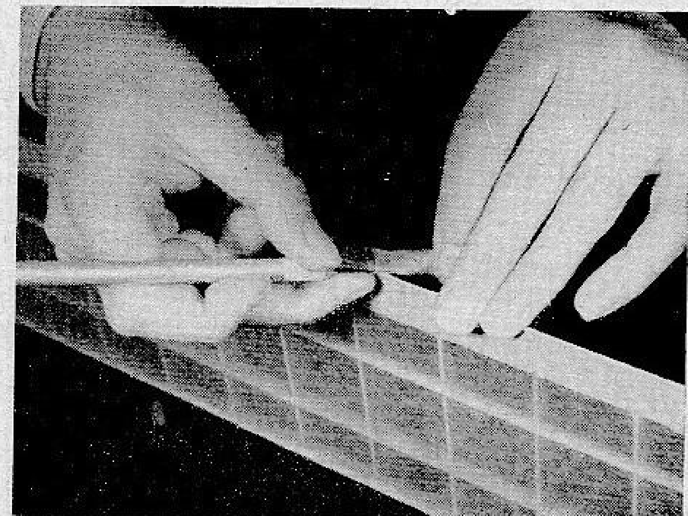


Fig. 10. Trimming off the trailing edge; be careful not to cut into the wood with the knife edge.

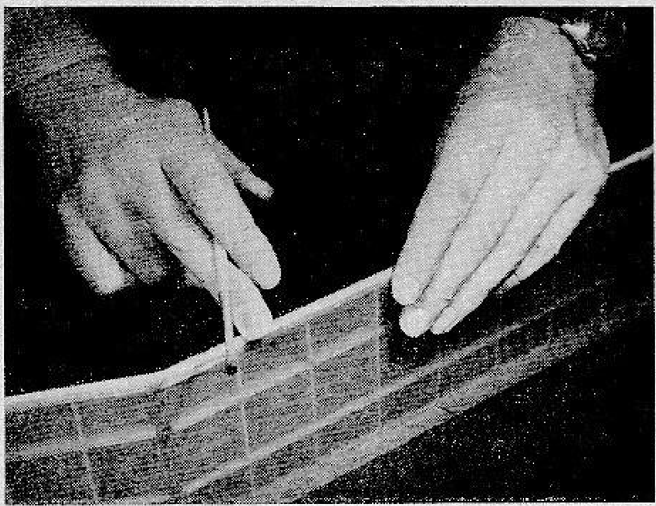


Fig. 11. Sealing down the edges of the tissue with dope by rubbing along them with the finger.

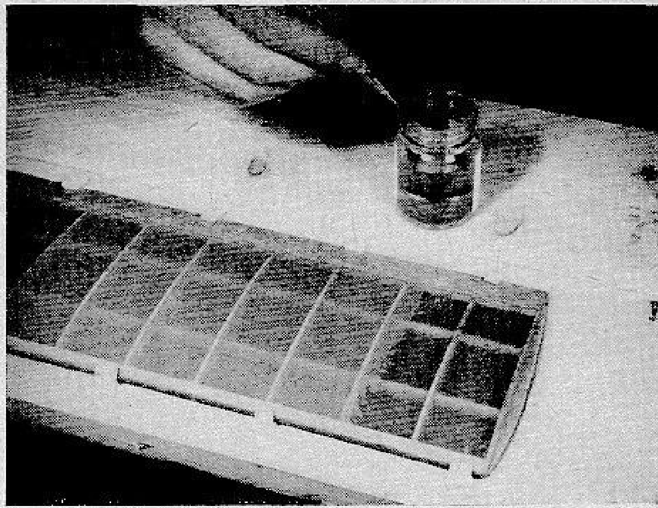


Fig. 12. Wing and tail surfaces should be pinned down when doped to prevent them from warping.

flat and drop the pasted bottom surface of the frame on it. Holding the component in both hands, stretch the tissue lengthwise.

Fig. 8. Now pull out across the chord at the centre.

Fig. 9. (Wing.) Work diagonally out towards the corners. Do not attempt to get the tissue exceptionally tight: you will only succeed in producing wrinkles across a section you have previously stuck down and you will have to keep raising the covering again to pull these out.

Fig. 10. Trim off with a razor blade or *sharp* modelling knife. (It is unnecessary to fold over the trailing edges, incidentally.)

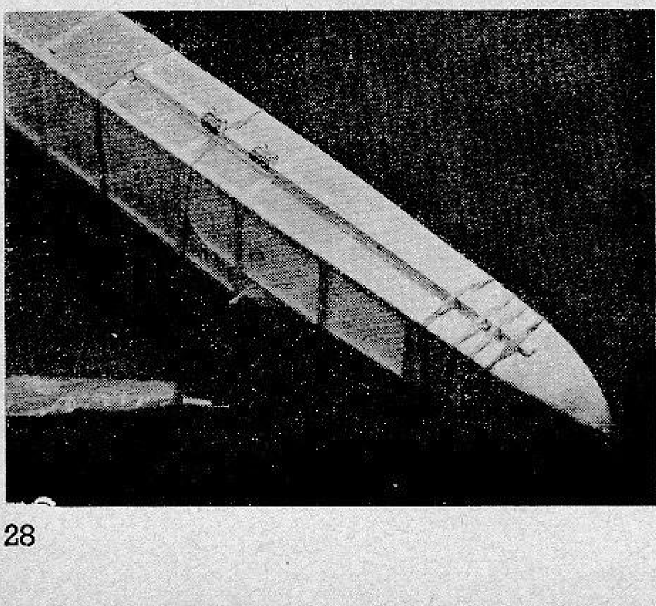
Fig. 11. Seal the edges with dope.

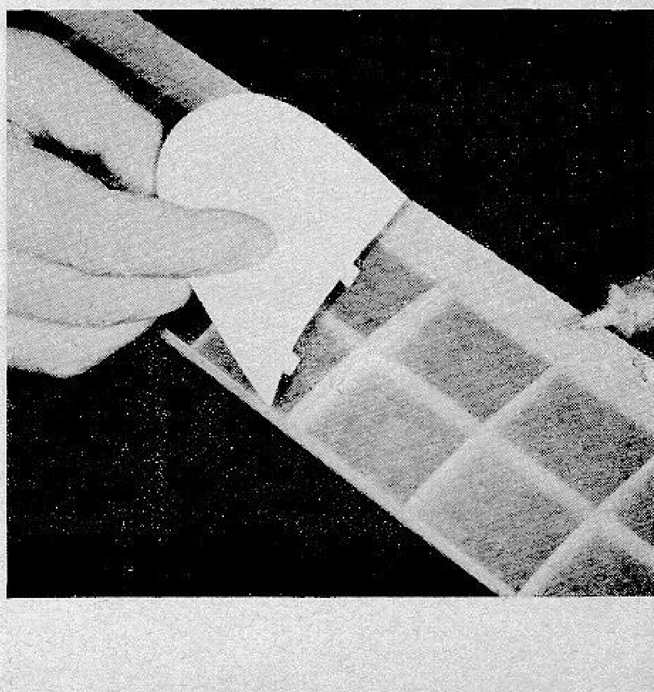
Fig. 12. It is most important to pin down flying surfaces while they are drying in order to prevent warping. Dope the underside first, then, supporting it on a number of scraps of $\frac{1}{16}$ in. sheet balsa, pin it down with drawing pins or scraps of balsa and household pins as shown. Then dope the top surface while it is in this position. Leave the surface pinned down as long as you can. It is a fact that any new structure takes some time to settle into shape and the first few days after covering and doping are especially critical and it is worth while to keep your flying surfaces pinned down while they become duly " inoculated " against the effects of atmospheric changes while held true.

It will be noticed that only the outline frame of any component is treated with adhesive—never the cross-members or ribs. It is necessary that the covering is eventually stuck to the entire framework in order to brace the complete structure, but the dope will do this, later, by soaking through the tissue and bonding it to the wood. To have adhesive over the entire framework when actually applying the covering will only hinder operations. The sole exception to this rule concerns wings with a concave undersurface. It is then necessary to use glue or cement on the bottoms of the ribs to ensure that the tissue follows the required curve and does not pull away when shrunk.

Exposed wood parts of the model may be treated with two or three coats of clear dope or, alternatively, a non-shrinking dope, such as " banana-oil," which also gives a pleasant gloss, may be used. Banana-oil may also be used as a final coat on tissue covered surfaces.

Below. On the " Tutor " glider, the nose skid, with towhooks, is cemented on after covering and can be held in place with rubber bands until dry. Right. Fitting the " Tutor " fin to the completed tailplane.





Trimming and Flying

CHAPTER SEVEN

IF we were asked: "Which is the most important stage, building a model or flying it?" we would be tempted to reply: "Neither!" because in between completing a model and flying it, there is a certain amount of checking and adjusting to be done which is without doubt the most crucial stage of all.

Trimming, as we call this procedure, does not take very long and with a model glider is quite a simple business if tackled correctly. Properly carried out, it can result in a highly satisfactory performance—even from a model which is by no means an exhibition piece as regards constructional neatness. On the other hand, the most beautifully made model can be quickly reduced to a wreck if vital adjustments are ignored.

Let us assume that we have before us the completed *Tutor* glider components: fuselage, wing and tail unit. The first thing to do is to give each of these a final check. We have already mentioned the importance of avoiding warped flying surfaces during the covering and doping stage. Check the wing and tailplane again to make sure that neither of these has since developed a warp.

To do this, hold the unit in both hands at arm's length with the trailing edge towards you (Fig. 1). By lowering the leading edge slightly, you can now sight across the chord (lower surface) and note whether the trailing edge is precisely parallel with the leading edge, as it should be. An alternative method, of course, is to lay the component on a perfectly flat and true surface—if such is available.

There are two main types of warp. The first, a longitudinal twist, means that one part of the wing will be inclined at a different angle to the airstream from another. The second is a longitudinal curvature and generally means that the wing or tail is bowed upwards slightly.

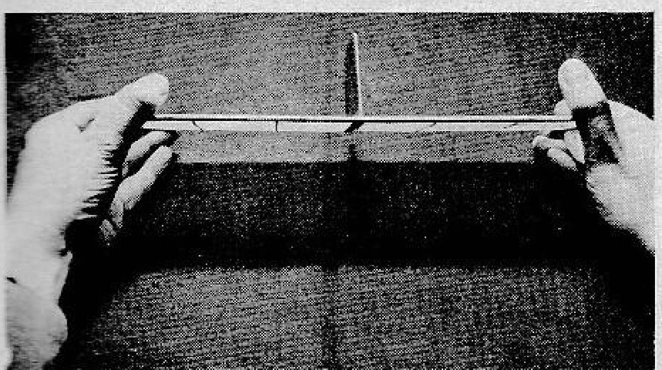
The most likely warp to be encountered in a wing is the twist in which the tips are at a different angle from the centre section. In a few cases, a slight warp of this type *can* be tolerated. If, for example, the trailing edge at *both* tips is turned upwards slightly (*not more than $\frac{1}{8}$ in. in the case of the " Tutor " glider*) and to an equal extent in both tips, this may be ignored.

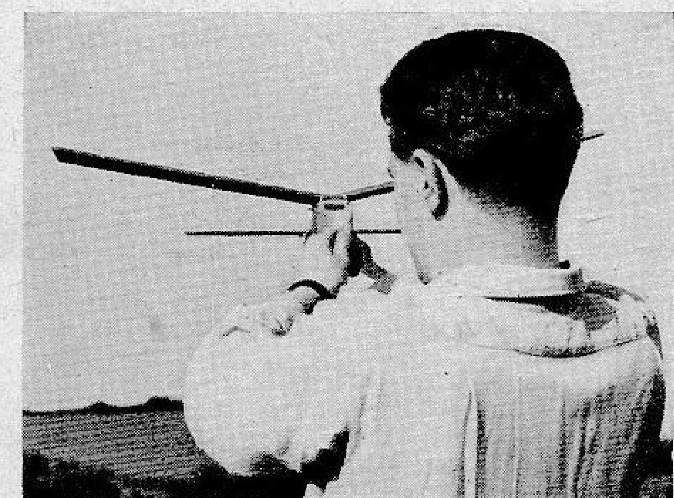
Any other twist must be corrected.

A slight upward curvature from tip to tip (not uncommon with certain types of tailplane structures) may

Fig. 1 (below). Checking the tailplane for warps by lining up the leading and trailing edges.

Fig. 2 (right). Checking the alignment of the flying surfaces on the fuselage.





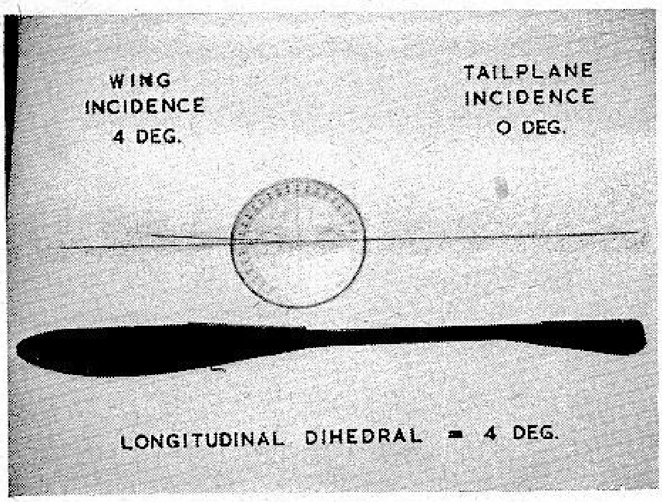


Fig. 3. The meaning of longitudinal dihedral. (Mercury "Gnome" glider fuselage.)

also be ignored—*provided that the surface is not also twisted longitudinally.*

While it is best to avoid warping at the outset by careful attention to covering and doping and leaving the unit pinned down as long as possible, a twist can be taken out as follows.

Hold the unit comfortably in front of you with both hands across the chord and positioned at each end of the section to be straightened. Exert sufficient twisting action to bring the surface back in alignment, plus a fraction in the opposite direction. Now hold it thus in front of an electric radiator, or some such similar source of heat, for about 20 to 30 sec. so that the whole section becomes slightly warmed. You will probably feel a slight tendency for the surface of "relax" at this point. The surface should then be transferred (while still holding it set) to a cool part of the room for a minute or two. On release, it will be found that the offending warp has been removed. You will soon find it quite a simple matter to reset surfaces true by this method.

The next thing to do is to check the alignment of the wing and tail on the fuselage. First make sure that they are level on the fuselage—i.e. that one side is not lower than the other and that the wing and tail are in line with one another. The quickest way to check this is to hold the model at arm's length in front of you as in Fig. 2.

Now hold the model vertically in front of you to check that the wing and tailplane are not "skewed"—i.e. that they are at right angles to the centre-line of the fuselage in plan view. If you do not have a very good "eye" for this sort of thing, a simple check can be made with a pin attached to a length of thread. First push the pin into the tail of the fuselage and measure the distance to a convenient point on the wing tip. Check this against the corresponding point on the other wing tip. (On the *Tutor* fairly accurate alignment of the wing is ensured by the fact that the V centre-section is cradled between the top longerons.) The same method is used for aligning the tailplane. In this case, of course, the pin is pushed into any convenient centre point on the fuselage, towards the nose.

To enable alignment to be quickly re-established at any time, it is a good idea to mark the respective components with suitable centring lines. Alternatively, in the case of tailplanes with fixed vertical fin surfaces, a better method is to "key" the tail unit on to the fuselage so that it cannot move and upset directional trim.

The simplest way of doing this is to cement four small pieces of $\frac{1}{16}$ in. sq. balsa on the underside of the tailplane so that they butt against the sides of the tail platform, front and back, on both sides.

Both wing and tail surfaces are usually held in place on the fuselage with rubber bands. These form an effectively firm, yet shock-absorbent, method of attachment. Make sure that you have sufficient rubber to prevent the surface from lifting during flight, and remember that strong bands, lightly stressed, are better than thin bands stretched to their limit.

The essence of successful flight is stability. In Chapter III we discussed the general principles of aeroplane flight and how stability is obtained in various directions, namely longitudinal stability, lateral stability and directional stability. The latter two, we discovered, were effected by the *dihedral angle* of the wings and the rearward *vertical fin area* respectively. Both these features are readily apparent in our elementary glider model. Longitudinal stability, we found, was obtained by rigging the wing at a larger angle of attack than the tailplane.

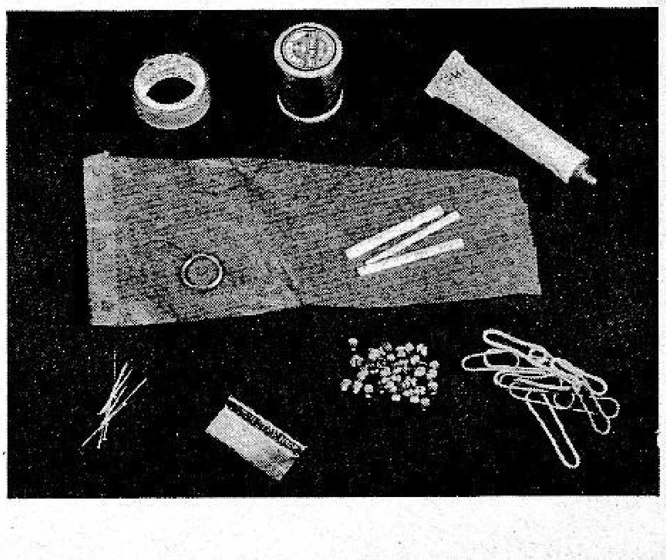
Referring to Fig. 3, we see how this can be checked. The model used in this illustration is a Mercury *Gnome* glider. The fuselage was laid on a sheet of paper and lines were drawn parallel to the tailplane and wing platforms. Using a protractor as shown, the wing angle of incidence was found to be 4 deg., while the tailplane was at zero degrees.

Sometimes a model may have only 3 deg., 2 deg. or even slightly less, difference between the wing and tail angles of incidence—the angular difference being known, as the *longitudinal dihedral angle.* The essential point to remember, however, is that a longitudinal dihedral angle must be preserved and that it is unwise, therefore, to make changes to the wing and/or tail incidence that will seriously reduce the longitudinal dihedral, when trimming the model.

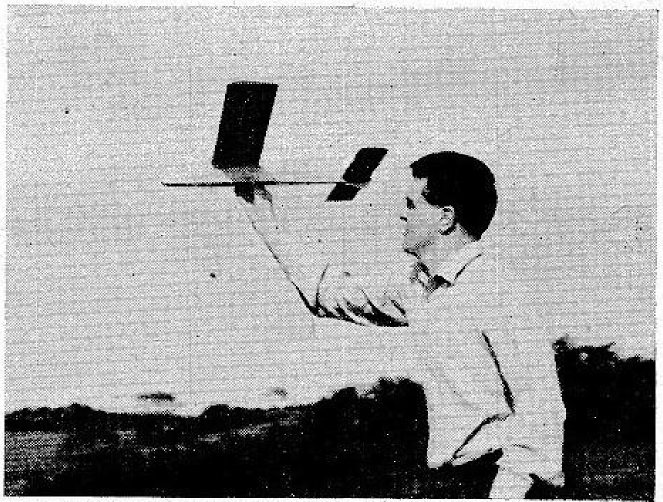
To avoid this possibility, the model is provided with a nose ballast box. By this means, longitudinal trim may be altered merely by adding or taking away weight, to adjust the centre of gravity position.

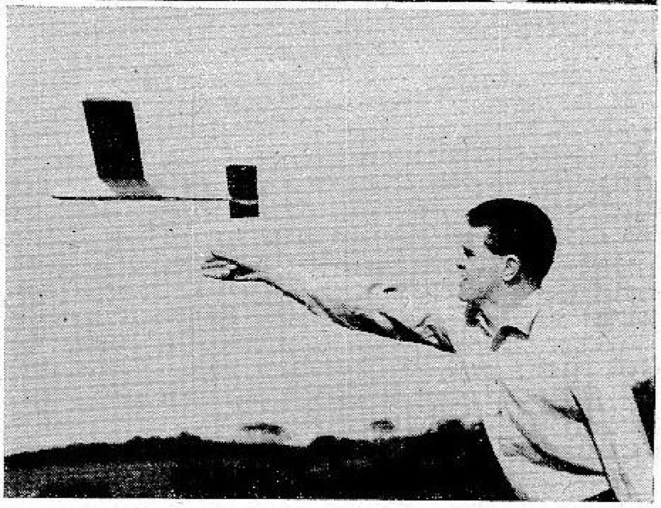
The plans of the *Tutor* show the balance point (c.g.) at about 38 per cent. chord—i.e. a little under 2 in.

Fig. 4. A simple field kit: cellulose tape, button-thread for tow-line, cement, coloured tissue pennant, towing ring, thin strips of balsa for incidence packing, pins, razor blade, lead ballast and rubber bands.



Figs. 5 & 6. An expert test-glide hand-launch. Note how the model is smoothly projected into its natural flying attitude.





back from the leading edge of the wing. On the test model it was found that, in fact, the model flew satisfactorily with the centre of gravity about half an inch farther back, with a consequent saving in ballast weight. It is suggested, therefore, that ballast is added to the weight box until the model balances at about 50 per cent. chord. If subsequent test flights indicate that this is not sufficient ballast for your particular model, it is a simple matter to add some more.

We are now ready to gather together the various small items of "field kit" needed for our test flights (Fig. 4). The first requirement, of course, is the ballast weight we have already mentioned. Lead shot is very suitable. Alternatively, you can use air-gun pellets as shown, about 3-4 dozen 0.177 calibre being required, or you can chop up any old bits of scrap lead or solder that you might have handy. To seal the ballast box hole and prevent inadvertent changes of trim due to accidental loss of shot, some cellulose tape is useful—or a simple plug can be devised.

For a towline, some strong button-thread is all that is required. Tie a curtain ring or hoop of wire on the end and cement a pennant of coloured tissue—about 6 in. × 4 in.—to the thread a few inches down. The pennant has a number of uses: it enables one to determine the exact moment when the model is released (of particular importance for precise flight timing); it assists in disengaging the line from the towhook and it is helpful in locating the towline should this be dropped in the grass.

Further useful additions to the field kit are a tube of cement, some strips of 1/32 in. balsa, some spare rubber bands, pins and a razor blade.

Needless to say, a calm day is essential for test flying. Fresh or strong winds are not only dangerous for the model, they also make it extremely difficult to judge the effect of different adjustments. Often it will be found that the evening, or early morning, is the best time. Don't fly the model near trees, thick hedges or buildings. Long grass or soft turf are the best spots from which to conduct initial tests.

Assemble the model, check alignment and make sure that the rudder tab is central. Hold the model slightly behind the balance point and with the nose into the wind. (The word "wind" is not to be taken too literally, of course; as we have said, calm conditions are the rule for testing.) Point the model downwards very slightly. Do *not* point the nose skywards.

There is a knack in getting a smooth launch. One does not need to run with a model of this size, but it should not be merely tossed into the air. Launch as smoothly as you can, letting go of the fuselage as your arm is extended to its fullest extent and with a follow-through action. Figs. 5 and 6 show this action precisely.

The model should glide down gently on an even keel. If it should veer left or right, look again for warps and check fin alignment. If necessary, use the rudder tab to counteract excessive turn (Fig. 7).

It is difficult to say how far the model should glide when correctly adjusted since this depends on the strength of any wind present. An almost imperceptible air movement will shorten the distance, but, in conditions of dead still air, a good model should touch down ten or a dozen yards away when it is launched from a height of between five and six feet.

Fig. 7. Any tendency for the model to veer left or right can be corrected by slight adjustments to the rudder tab.

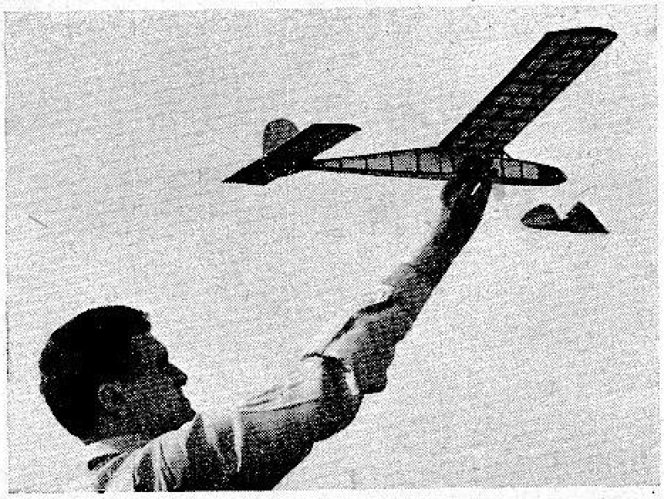


Fig. 8. The position for towline launching: wings level and nose slightly raised.

If you can launch from atop a slight slope, so much the better. This will give a longer flight that will give you a better opportunity to check the effect of adjustments.

If the model stalls, i.e. raises its nose, slows up and then dives, this may be due to your having launched it too fast, or to the wind being too strong, or to a little of each. Therefore, check this again before making any adjustment.

If the model continues to stall, you can do one of two things: add ballast or pack up the leading edge of the tailplane. On the *Tutor*, it is inadvisable to increase the angle of incidence of the tailplane as the longitudinal dihedral is small and adding further ballast is, therefore, the preferred method. If, however, the model tends to dive, the trailing edge of the tailplane should be packed up with thin strips of balsa until the model just begins to stall.

Fig. 9 (below). Ready for the start of a towline launch. Note how the operator is indicating to his helper that he is ready to proceed.

Two courses are now open to you. Either you may remove a little packing (or add a little ballast) sufficient to iron out the slight stall, or you may adopt the contest-flier's method of setting the rudder tab over to give a slight turn. This latter is the more popular for towline launched flights. The turn will automatically dispose of the slight stall and the model will be flying very close to its minimum sinking speed.

Basic towline technique needs a little practice but is really quite simple if you observe the rules. For this you will require the services of a helper.

Use only 25-30 ft. of line to start with. Slip the towing ring over the rear hook. The model should be held straight into the wind as for a hand launch, but with the nose inclined upwards slightly (Fig. 8). Your helper should now hold the model in this position while you take up the other end of the towline.

On a given signal, your helper should be prepared to release the model as you trot away, towing the model behind you. Keep an eye on the model while you are towing. It should climb fairly briskly at first, but if it fails to climb and merely slips off the hook, you are not towing fast enough. Try again.

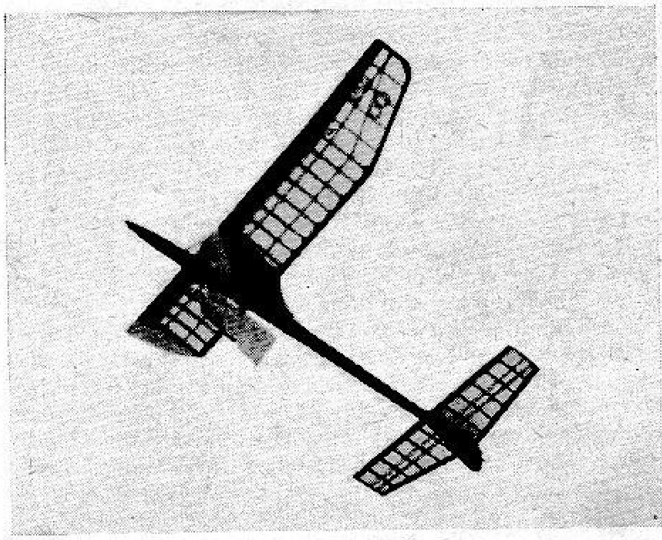


Fig. 10. Going up. A typical climbing attitude a few seconds after release.

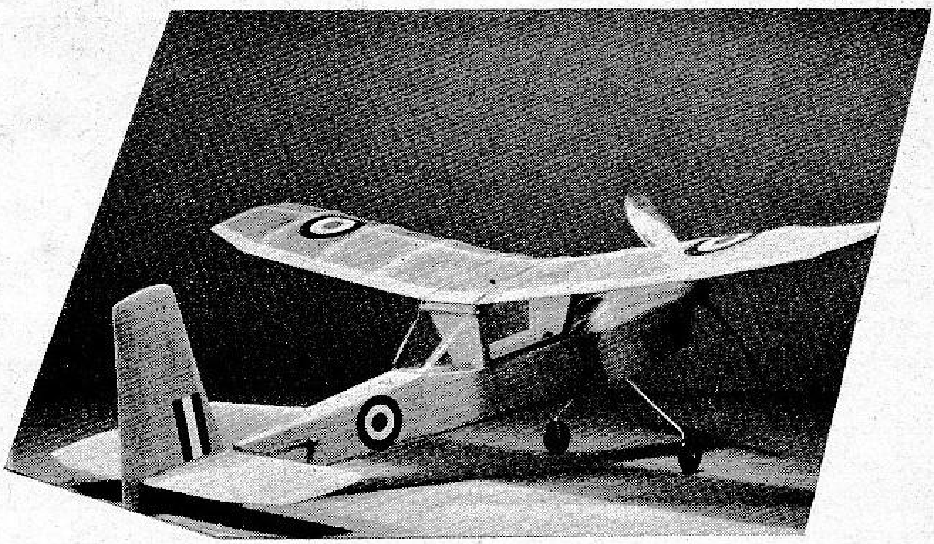
Slow up your tow when you feel the model pulling strongly. If the model turns off one way, run in that direction so as to line up the model with the direction of the tow.

Eventually you will reach a point where the model cannot be persuaded to go any higher. This point is dependent on the design of the model, the position of the towhook relative to the c.g. and on your skill. At this point you should stop towing and let the line go slack. It will slide off the hook and the model will begin its glide.

We have purposely avoided mention of the finer points of towline technique. These really go with more advanced models and need not concern us in our present ground work.

You will observe that most model gliders are fitted with two or more tow-hooks, or an adjustable hook. The rearward positions are for calm weather towing, while the forward hook can be used under more windy conditions. When you have gained some practice, the towline length may be gradually increased to 100-150 ft.

Rubber Driven Models



WE began our series of construction sequences by recommending and describing the building of a simple medium sized glider. We did so because we are of the opinion that this is the best type of model with which to learn the construction principles common to most models, while, at the same time, providing the newcomer with a finished model which can be expected to perform reasonably well in his rather inexperienced hands.

CHAPTER EIGHT

A glider can provide a good deal more interest than many beginners realise. Nevertheless, there will be some readers who prefer the idea of a propeller-driven aircraft or who, having built a glider, now wish to try their hand at a rubber powered model.

Rubber driven models are of various types, ranging from the simplest stick models, through small and medium sized scale, semi-scale and duration models, to large Wakefield class contest models.

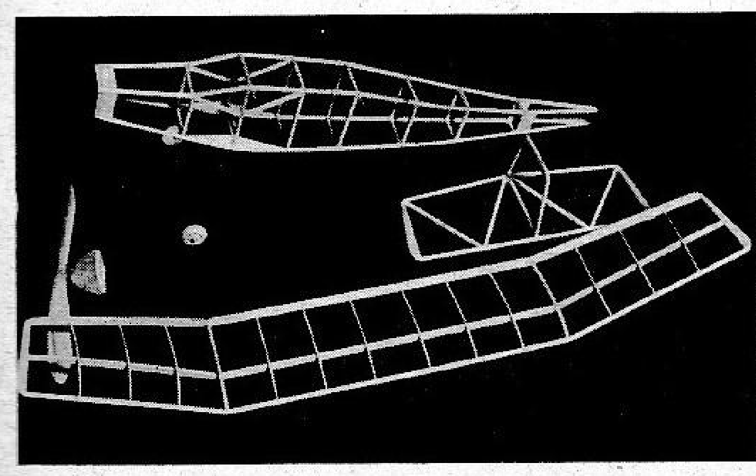
In the medium sized duration model category there are a number of designs in which the construction is basically similar to that of the glider dealt with in Chapter 4, 5 and 6. There is, in fact, very little difference between the structure of the 30 in. span Jasco *Tutor* glider featured and its companion rubber model, the Jasco *Triumph*.

Other kit models of this class include the Keilkraft *Ace*, *Ajax*, *Achilles* and *Senator*, the Skyleada *Fledgling* and *Husky*, the Veron *Rascal* and *Sentinel* and the Frog *Goblin* and *Minx*. These models range from 24 to 36 in. wingspan, and have an excellent performance.

The main points of difference between the *Tutor* and rubber models of this type are to be found in the addition of an undercarriage, stranded rubber motor and airscrew, while the noseblock is made detachable and is drilled to support the propeller shaft. The ballast box is, of course, omitted.

The undercarriage on a rubber model is usually very simple, of steel wire, and bound and cemented to the framework. Make sure that it is well secured. It is much easier to fix an undercarriage properly while the model is being built, than to have to strip off the covering and refit it later.

Remember that, unlike the glider, the rubber model fuselage has not only to support the other components, but has also to resist the twisting force (and, to a lesser



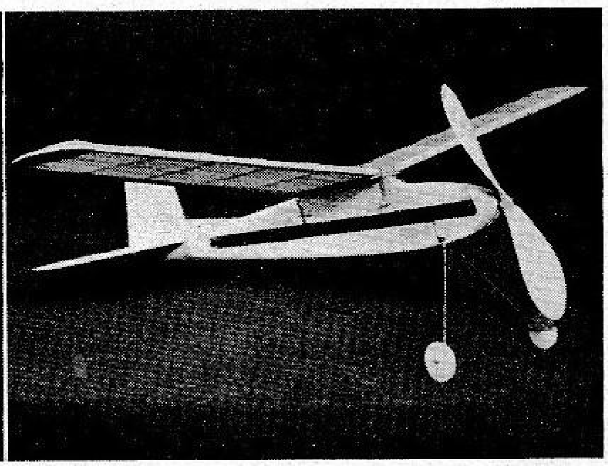


Fig. 1 (left). The framework of a typical rubber driven kit model: the Skyleada "Fledgling." Fig. 2 (right). Successor to the stick model of bygone years, as an easy to build beginner's model is the "profile" type. Here is an example built from a magazine plan.

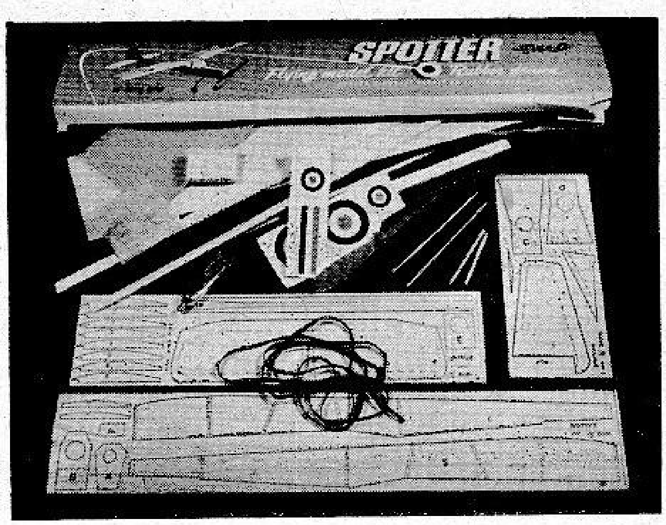


Fig. 3. Scale and semi-scale models are very popular. Shown here is the kit for the Jasco "Spotter," a completed model of which is shown in the heading photo.

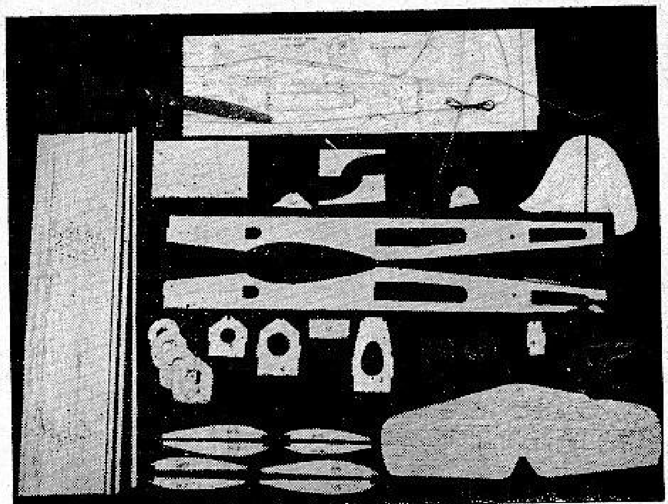


Fig. 4. Other examples of inexpensive small rubber model kits are to be found in the Frog Senior series, which include many ready formed parts.

extent, compressing action) of the rubber motor when wound up. Extra care should therefore be taken to ensure that all joints are strongly pre-cemented, especially at the front where the noseblock fits in.

Care should also be exercised in the drilling of the noseblock for the propeller-shaft bushing so that the thrustline is at the proper angle.

Rubber strip for the "motor" is made in two thicknesses (1/24 and 1/30 in.) and three widths ($\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ in.). In some small kits (notably Frog) the strip is supplied in loops of the appropriate length, but in nearly all cases, it is necessary to join the ends of the strip to make up loops or skeins. The most satisfactory method of doing this is to tie them in a reef knot (Fig. 5) and to then secure the ends close to each side of the knot with a few turns of thread—while the rubber is stretched out.

Before use, the rubber motor should be washed, using a mild soap, and then thoroughly rinsed. When dry, it should be treated with *rubber lubricant*, a preparation consisting basically of pure soft soap and glycerin and available in tubes and jars from model shops. A little of the lubricant should be smeared on the palms of the hands and then thoroughly rubbed into the motor. As an emergency measure, castor-oil may be used in place of rubber lubricant. On no account, however, must ordinary lubricating oil be used as this will rapidly cause the rubber to deteriorate and break.

Before fitting the rubber motor to the model, wire hooks, such as that linking the motor to the propeller shaft, should be covered with rubber (bicycle-valve) tubing or plastic (Neoprene) tubing, in order to prevent the wire cutting into the motor. An alternative here, used with larger models, is the "run-true" bobbin.

Rubber should never be exposed to strong sunlight for longer than necessary, or to extremes of temperature and, when not in use, is best stored separately in a closed tin. If dust should be picked up by the strands, it is best to wash the motor and then relubricate it before re-use.

During the past ten years, duration type rubber models of the size we have mentioned and up to the largest (Wakefield) size, have declined in popularity due, mainly, to the wide use of small engines suitable for F/F models of 30 in. span and upwards.

More recently, however, there has been renewed interest in small quickly-built models that can be flown in restricted spaces. Kit manufacturers have responded

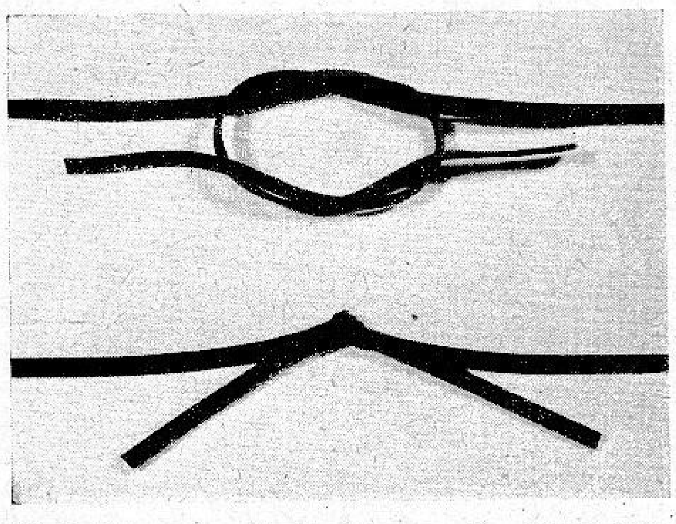


Fig. 5. Rubber strip can be joined by means of a reef knot. After the knot has been drawn up, it is locked with silk binding.

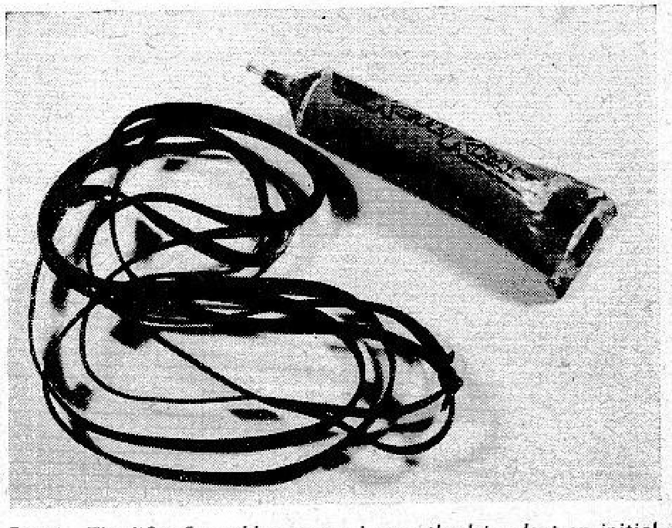


Fig. 6. The life of a rubber motor is greatly dependent on initial care. A new motor should be washed, then treated with lubricant.

with a large variety of designs in which many parts are ready formed, resulting in models that can be assembled in a matter of two or three hours.

Among models of this type are a number of good designs of 18 to 20 in. span and often of semi-scale appearance. These are to be found in the popular Frog "Senior Sports" series, the Mercury "Starflight" series etc.

Five steps in the construction of one such kit model, the Frog *Raven*, are shown in our photographic sequence Figs. 7 to 11. Much of the structure of these Frog models consists of diecut sheet-balsa parts and, with the exception of the wings, is put together without the need of pinning down to the assembly drawing.

These diecut parts are supplied in sheets from which they must be detached. Do not merely try to push out the parts from the sheets. Most diecutting is accurate but it is advisable to separate the parts with the aid of a razor blade to prevent ragged edges and splitting.

Most rubber model kits include a finished or semi-finished propeller. With the smaller models, many kits now contain finished props of moulded plastic. In the case of medium size and duration models, however, the prop is generally of the semi-finished, so-called "saw-cut" type.

It is also possible to buy finished balsa propellers in various sizes. However, where one is building from a magazine plan, and particularly in the case of Wakefield and other high-performance contest models, it is usual to carve one's own propeller from a solid block of balsa.

This is a good deal easier than might be imagined. The secret is in the simple process of first cutting the block to a given shape before starting to carve the blades. The dimensions, or a template for this, the "blank," are usually given on the plans of the model. Figs. 12 to 17 show the sequence of operations in carving such a prop.

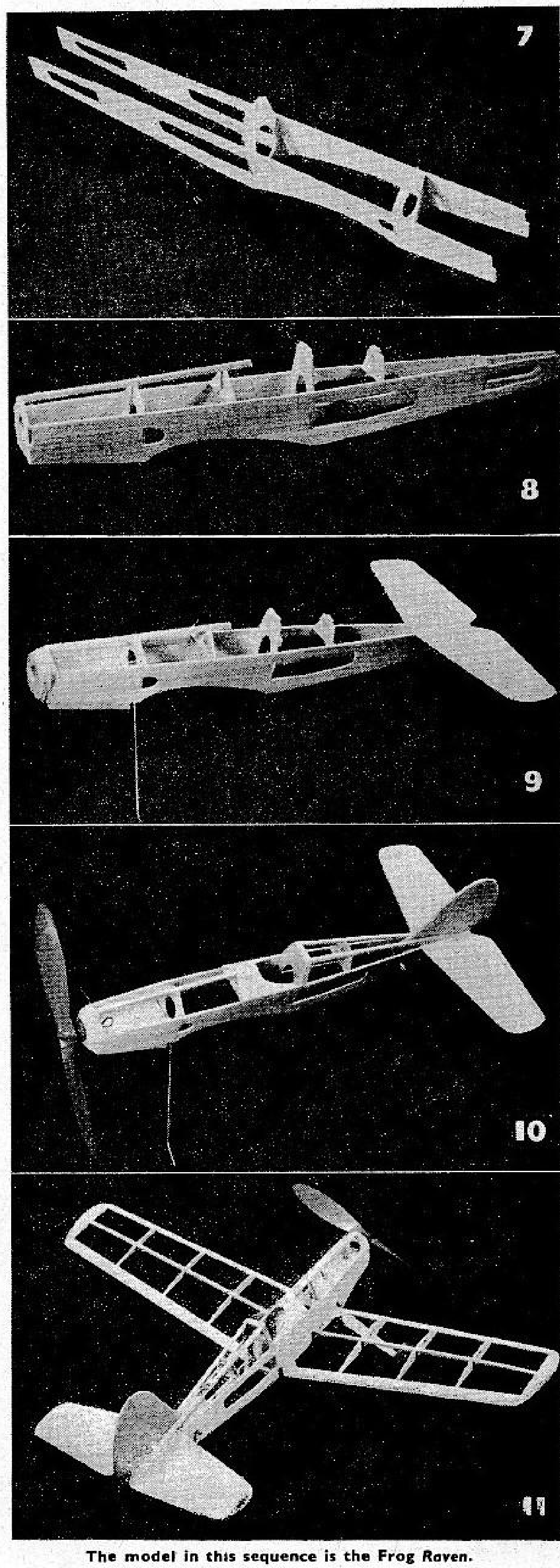
The first requirement is a piece of balsa as near to size as possible. The propeller shown in the photographs was of 18 in. diameter and called for a block 2 in. wide and $1\frac{1}{2}$ in. deep—a size easily obtainable. Choose a piece of wood which is of even texture throughout and not soft at one end and hard at the other.

A cheap ball pen is ideal for marking out the blank but if this is not readily available, a pencil can, of course, be used. First scribe the centre lines and other lines running around the block. Mark all four sides. From these the various tapers can then be marked off (Fig. 12).

Before beginning to cut out the blank, the shaft hole should be drilled. If you have access to a bench drilling machine, so much the better as this will ensure that the hole is bored truly vertically through the block. Most modellers, however, will have to use a small hand-drill.

Use first a $\frac{1}{16}$ in. drill and, with the block laid on a flat and level surface, centre the bit and, if possible, have an assistant to advise you whether you are holding the drill quite vertically. Drill only about one-third through the block, then reverse it and repeat operations from the other side. Then feed the bit through from each side until the two holes meet. Finally, ream out the hole with the appropriate size drill.

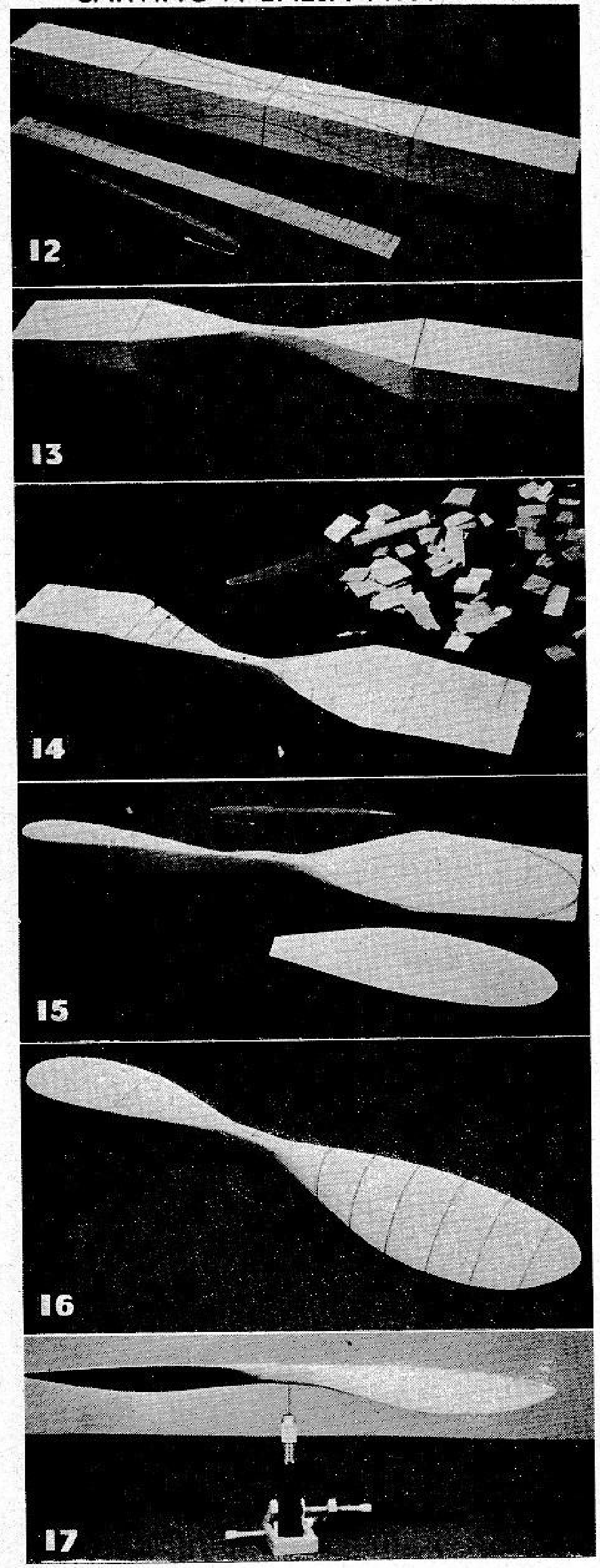
Start shaping the blank by cutting the end tapers—preferably with a tenon saw. These are followed by



The model in this sequence is the Frog Raven.

Figs. 7-11. Five stages in the assembly of a Frog "Raven" show: basic assembly of two side panels and two main bulkheads (7); addition of nose and tail bulkheads, formers and front stringer (8); addition of noseblock, undercarriage, cowl block and tailplane (9); completion of tail-unit, cockpit sides and rear stringers (10); addition of built-up wing, cockpit canopy, undercarriage fairings and wheels (11).

CARVING A BALSA PROPELLER



cutting the hub taper at the back. Cut slightly outside the guide-lines and rasp down level with them using a coarse sandpaper block. Now cut the centre tapers and shape up the blank to the lines with coarse, then medium, sandpaper blocks. Final shape of the blank immediately prior to carving is shown in Fig. 13.

Commence carving with the back surfaces of the blades. To assist accuracy and avoid risk of splitting off too much wood, it is a good idea to make a series of diagonal sawcuts through the back of the block, from leading to trailing edge of the blade to be cut. Run a $\frac{1}{16}$ in. pencil margin around the block and work to this to avoid sawing into the actual leading and trailing edges. For the actual carving, a modelling knife is not very suitable (except for small props) due to inadequate blade length.

When both back surfaces have been roughly carved to shape, they should be trued up with a straight sandpaper block, after which the required undercamber is put into each blade using the curved part of the knife and sandpaper. Check with a straight-edge to ensure equal undercamber on each blade. Next, mark out the required blade shape using a card template as in Fig. 15. Cut the remainder of the blank away to this shape.

Now carve the front surfaces of the blades so that a thin aerofoil section is obtained. This is really much easier than it sounds and you will be able to see and feel any unevenness in blade thickness as the work progresses. In Fig. 16 a series of parallel lines has been drawn across the blade showing the pitch graduation and gradually thinning blade section towards the tip.

Most beginners make the mistake of leaving their props much too thick, especially towards the tips. Don't be afraid to thin down the blades. The same applies to the saw-cut prop, which needs to have the blade section shaped and the trailing edge thinned down. Do not forget the hub of the prop. The blades should be cleanly moulded into it with a progressive taper for maximum strength and minimum weight. When you are satisfied with your two blades, the prop must be balanced.

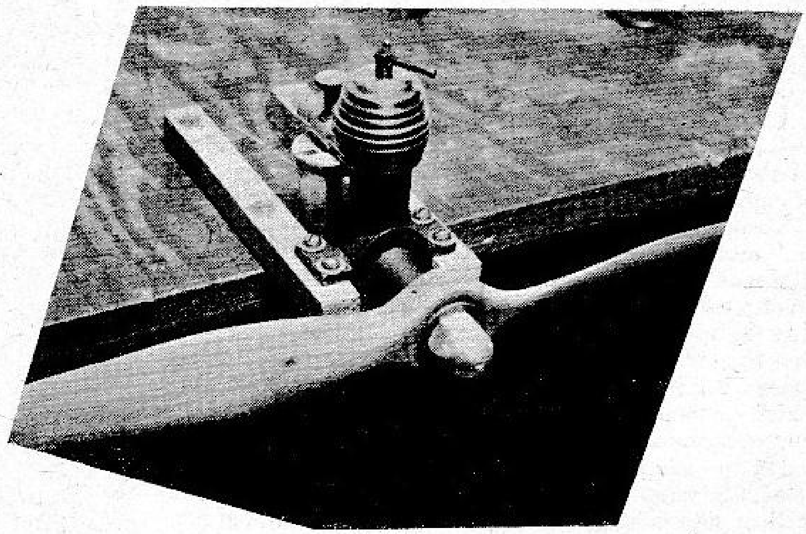
A rough check is obtainable by balancing the prop on a piece of wire through the shaft-hole but, for greater accuracy, it should be balanced on a knife-edge (Fig. 17). Horizontal balance is not necessarily true balance, however. Like a properly balanced wheel, a prop should stay in any position in which it is left and should stop in any position after spinning and not run back. If necessary, the leading edge of one blade and the trailing edge of the other will have to be sanded slightly to achieve this balance.

The whole prop can now be given several coats of banana oil to harden the surface and fill the pores of the wood. By rubbing down between each, about six coats can be brushed on without adding excessive weight and a good durable finish obtained. For rubbing down, use a very fine sandpaper. A final rubbing with No. 400 silicon-carbide paper will give a really smooth scratch-free surface.

Finally, a light application of wax polish, such as "Simoniz" or "Johnson's Wax," will preserve a smooth glossy finish.

Figs 12-17. Six steps in the carving of a balsa propeller for a duration model : marking out the blank (12) ; the blank cut to shape, drilled and ready for carving (13) ; carving the backs of the blades after diagonal sawcuts have been made to prevent splitting (14) ; marking and shaping the blade outline with the aid of a card template to ensure identical blade shapes (15) ; carving the front surface of the blade (16) ; when completed the airscrew should balance on a knife- edge (17).

Your first Engine



A FEW years ago, power modelling was very definitely for experts only and would have been quite outside the scope of this series—at least at this stage. The coming of small diesel and glowplug engines in the late nineteen-forties and of small, simple C/L models, however, altered all this. Nowadays, in fact, it is quite permissible (if not always financially practicable!) for the young beginner to start his modelling career with an engine-driven model.

CHAPTER NINE

Model aircraft engines manufactured today are nearly all of either the diesel or glowplug type. The advantage here is that there is no high-tension ignition system to go wrong, both types of engines operating by simple auto-ignition system. In general, modern model engines are easy to run and maintain and are very reliable.

It should not be assumed from this, however, that every model engine is suitable for the newcomer to power flying. This is far from the case. The hard school of contest flying has resulted in the development of engines of increasingly greater performance and many of these are too powerful, too big, too expensive or too tricky for the beginner to handle successfully.

Obviously, the newcomer to power modelling requires an engine that is easy to start and of a performance suitable for the types of models he will be building. Fortunately, there are many such motors.

In Fig. 1 is shown a selection of engines from many parts of the world. Six of them are diesels and six are glowplug models, and they come from six different countries: Great Britain, the U.S.A., Germany, Italy, Norway and Japan. It is fairly certain that, no matter what part of the world you reside in, you will be able to obtain at least one of these, for most of them are also exported to many other lands, including those countries which do not have their own model industries. British modellers should note, however, that foreign model motors are not at present generally available in Britain. This is of no great importance, of course, since the British market includes some ideal beginners' types.

Especially worthy of attention here are the Mills "75"

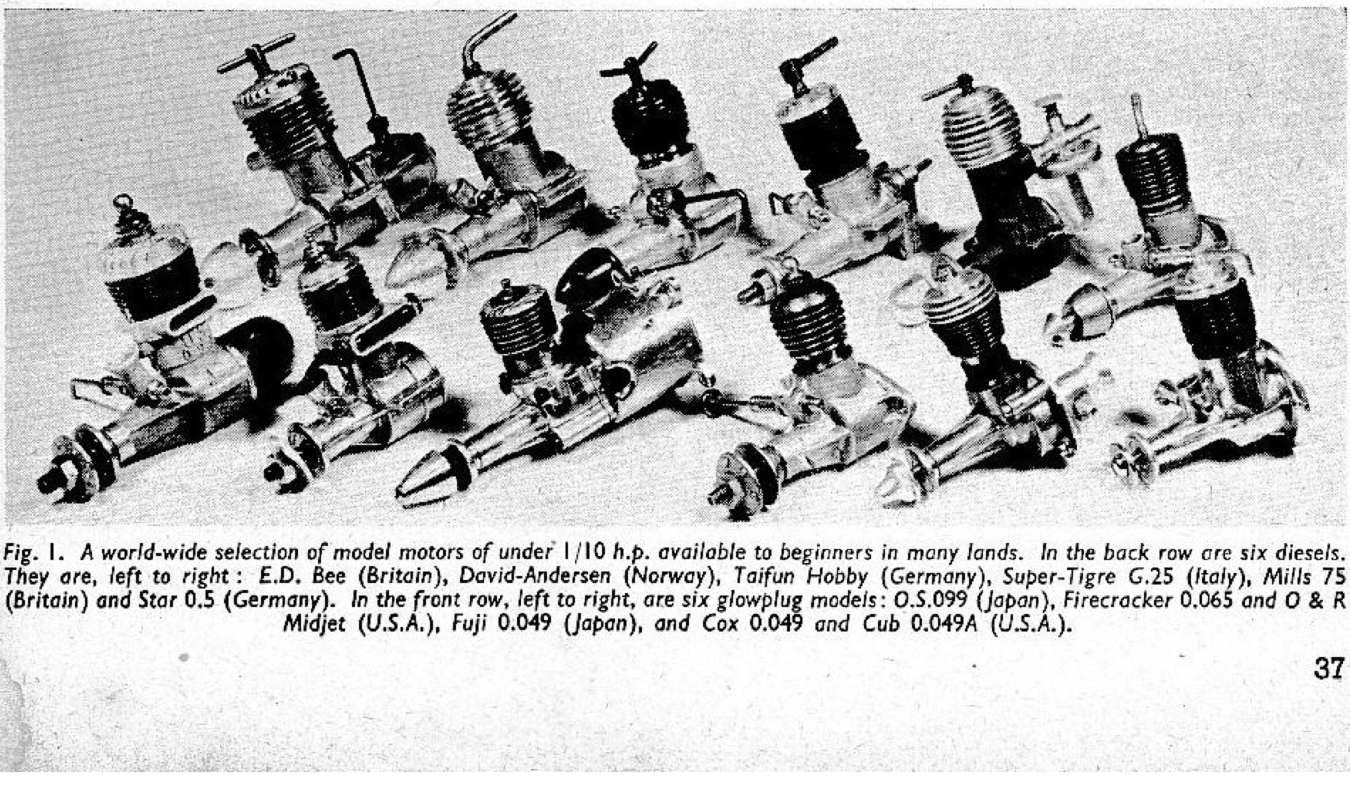


Fig. 1. A world-wide selection of model motors of under 1/10 h.p. available to beginners in many lands. In the back row are six diesels. They are, left to right: E.D. Bee (Britain), David-Andersen (Norway), Taifun Hobby (Germany), Super-Tigre G.25 (Italy), Mills 75 (Britain) and Star 0.5 (Germany). In the front row, left to right, are six glowplug models: O.S.099 (Japan), Firecracker 0.065 and O & R Midjet (U.S.A.), Fuji 0.049 (Japan), and Cox 0.049 and Cub 0.049A (U.S.A.).

and E.D. "Bee" models. The Mills "75," of 0.73 c.c. capacity, is the smaller of the two and is admirably suited to the many beginners' model designs on the market.

We shall be dealing with simple C/L models, suitable for engines of this size, in the next two chapters, afterwards going on to F/F models for which the same type of engine may be used.

These two engines are both of the compression-ignition or "diesel" type. It is not the purpose of this book to deal with the principles of internal combustion engines in detail, but, for the benefit of anyone totally unfamiliar with present day model motors, it should be mentioned that the model diesel has no sparking plug or electrical system. Instead, it has a high compression cylinder which detonates the fuel charge automatically. The compression-ratio (which is two to three times as high as for an ordinary petrol engine) is adjustable by means of a *compression lever* on top of the cylinder head which in turn moves a *contra-piston* in the top of the cylinder. See Fig. 2. Most European model motors are of the diesel type.

In the other type of engine, the glowplug motor, ignition is achieved differently. Here, a plug carrying a small platinum wire filament is fitted in the cylinder-head in the same way as a sparking-plug. This plug is simply connected to a 1½-2 volt battery, which causes the filament to heat up to a bright red colour. The engine is then started and the battery removed, the heat derived from combustion now being sufficient to keep the plug glowing continuously and provide ignition for each fresh intake of mixture.

Both types of engines are, of course, of the simple two-stroke type and both are fitted with a needle-valve type carburettor control. This simple device controls the amount of fuel admitted and thus the strength of the air/fuel mixture reaching the cylinder. If the mixture is either much too weak or much too strong, the engine will not work. Therefore, we adjust the needle-valve to get the correct mixture.

On a glowplug engine this is, in fact, the only control we have to worry about. On a diesel, however, as we have seen, there is an extra control: the compression lever.

The real purpose of this control is to adjust the timing of the ignition of the fuel charge. This is necessary in order, firstly, to assist starting, secondly to enable different propellers to be used (which cause the engine to run at different speeds) and, thirdly, so that the natural warming up of the cylinder (which will cause the fuel vapour to ignite too soon) can be compensated by reducing compression.

The fuel we use in our diesel is a special blend containing ether, which, when vaporised or atomised, ignites easily when compressed and ensures easy starting. Many good branded fuels are available, usually costing about 3s. for an 8-oz. bottle, but if you are some way from a model shop and cannot get a proprietary blend, a good substitute can be made with equal parts of ether, paraffin (kerosene) and castor oil. Glowplug engines require a different fuel consisting, mainly of methanol and castor oil with certain additives.

Every modeller finds his first engine an absorbing interest in itself, quite apart from the interest attaching to its future use as a means of propelling models, and it is natural to want to try out the engine before building a model for it. In fact, this is a good idea in any case, since, by first running the engine on a bench, the modeller will soon learn how to handle it.

Most model engines are of the beam mount type with

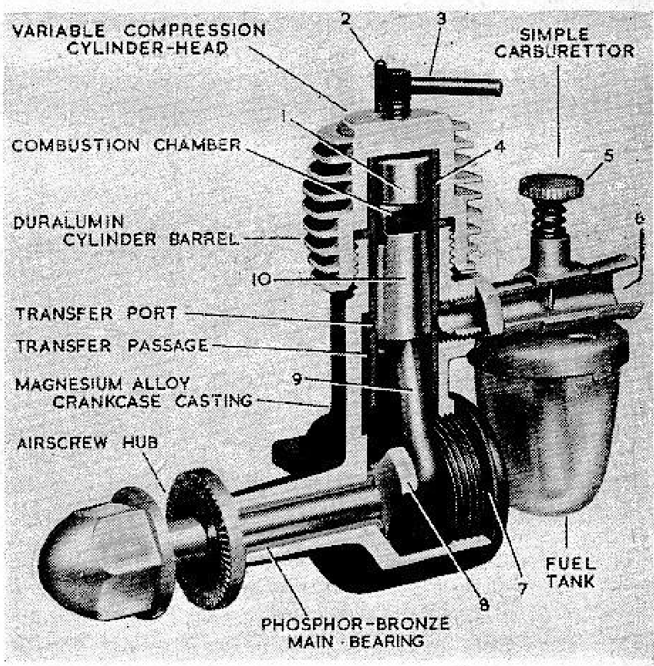


Fig. 2. A MODEL AIRCRAFT cutaway drawing of the British Mills 75 diesel motor. In addition to the main features indicated, parts are as follows: 1—contra-piston, 2—compression stop, 3—compression lever, 4—cylinder liner, 5—needle-valve control, 6—air intake, 7—crankcase backplate, 8—crankshaft web, 9—connecting-rod, 10—piston.

flat lugs on either side of the crankcase, permitting them to be bolted down on to two wooden bearers extending back into the fuselage. For bench running, these bearers, which should not be less than ⅜ in. square in section, may be screwed down to a bench, as shown in Fig. 4. Use small machine screws and nuts (not woodscrews) through the engine lugs with washers to fix the motor.

An alternative method of beam mounting is to use a flat piece of wood in which a U-shaped cut-out is made to fit the crankcase of your engine, as in Fig. 5. A third system is a special engine stand such as that shown in Fig. 6. Such a mounting can be purchased from your model shop and is adjustable to take various size motors.

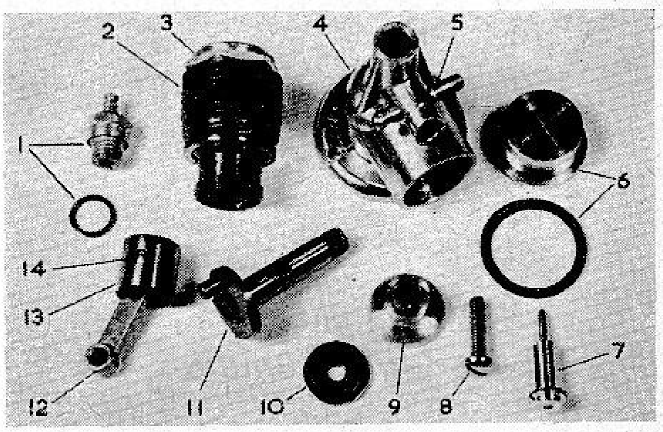


Fig. 3. The parts of a typical small glowplug engine. 1—glowplug and washer, 2—cylinder, 3—cylinder-head, 4—crankcase, 5—carburettor spraybar, 6—crankcase backplate and gasket, 7—needle-valve, 8—propeller screw, 9—prop drive hub, 10—prop washer, 11—crankshaft, 12—connecting-rod, 13—piston, 14—gudgeon-pin.

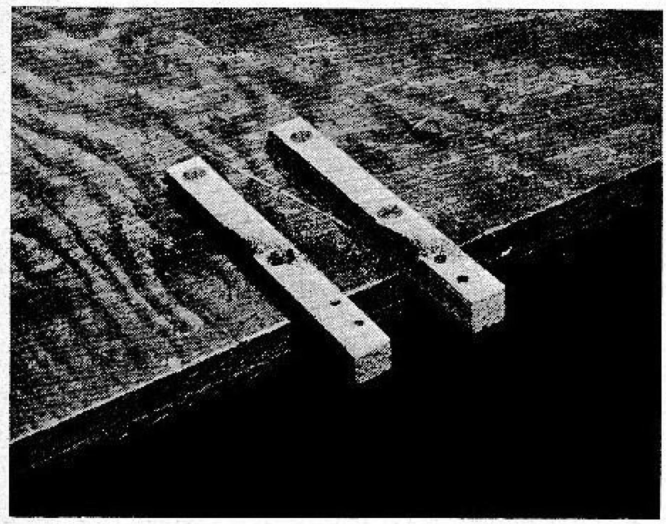


Fig. 4. The usual method of mounting is by means of two hardwood bearers. For initial testing they may be screwed to a bench.

Engines having bulkhead or radial flange type mounting can simply be bolted to a suitable piece of wood, which is then gripped in a vice or screwed to the bench.

When fitting the propeller, tighten it on the shaft in such a position that when one blade is brought gently up against compression, the airscrew rests in an approximately horizontal attitude. (See heading photo.) By this means, we can ensure that when a model is gliding down after the engine has stopped, the airscrew is in the best position to avoid a blade being broken off on rough ground, or the engine shaft being bent. This is also a good position to aid starting, as, standing to the left of the engine, it allows a good strong swing or " flick " to the prop, with the right hand, which then follows through towards the body.

To flick the prop effectively, place the forefinger (or forefinger and middle finger if you wish) fairly close to the boss or hub of the airscrew as in Fig. 8. In this position, one gets the most rapid and efficient flick for a quick start and the fingers are well out of the way when the engine starts.

As regards actual prop sizes, let the maker's instruction leaflet be your guide. For learning to start a Mills 75 we would recommend an 8 in. diameter, 4 in. pitch prop. For the Bee, the manufacturer's $7\frac{3}{4}$ in. $\times$ 6 in. prop is very suitable. Err on the large side, rather than the small side, when learning to handle your engine. For small glowplug motors, however, a smallish propeller is to be preferred as these engines are happiest at somewhat higher speeds. A 6 in. $\times$ 3 in. prop is the usual recommendation for a 0.049 (0.8 c.c.) glowplug engine.

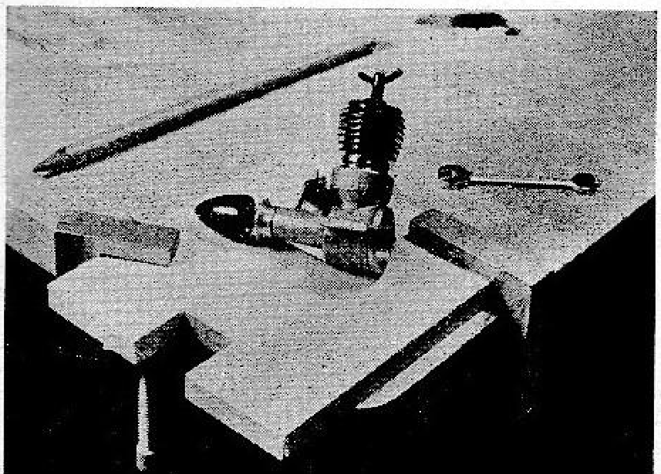


Fig. 5. Another mounting is a flat piece of wood with a cutout for the crankcase and secured to the bench with X-acto clamps.

When first attempting to start your new model engine, you may be rather discouraged by the results of your efforts. *Don't worry about this at all.* Model engine starting is, very definitely, something that has to be learned. The more you persevere with your engine, the quicker you will acquire that " engine sense " by which you will automatically begin to do the correct thing. By touch and ear alone, you will then be subconsciously guided in making the right movements. This is worth far more than any amount of words and the following notes are, therefore, intended only as a guide to setting you on the right course, by which you may learn for yourself, the correct handling of a model engine.

We are confining our notes on starting to model diesels, at this stage. Many of these recommendations are also applicable to glowplug motors, but further information concerning glowplug engine characteristics will be found in Chapter 16.

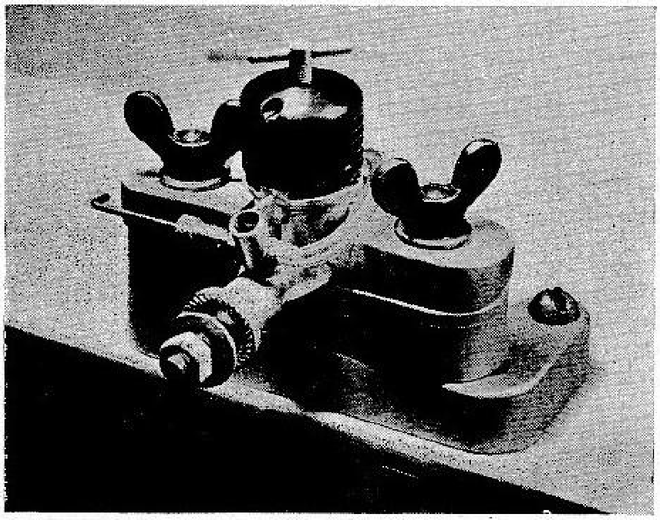


Fig. 6. An aluminium, adjustable bench mounting which is suitable for all types and sizes of beam mount engines.

First, check that the control settings are in accordance with the maker's instructions. Flick the engine over several times. Take notice of how the engine feels and sounds while you are doing this.

Now fill the fuel tank, place a finger over the end of the carburettor air intake to completely choke it and turn the prop three or four times. (Fig. 7.)

Uncover the intake and flick the prop once or twice. You will note that it now sounds " wet " and that there is a slight sucking sound in the carburettor. You may, if you are observant, also notice that the engine turns a little more freely—due to the lubricating action of the fuel which loosens any gummy residual oil.

The engine should now start within a few smart flicks of the prop. If it does not fire within, say, 20 flicks (we are tending to err on the generous side to avoid risk of flooding), choke the intake again for a couple of flicks and try again.

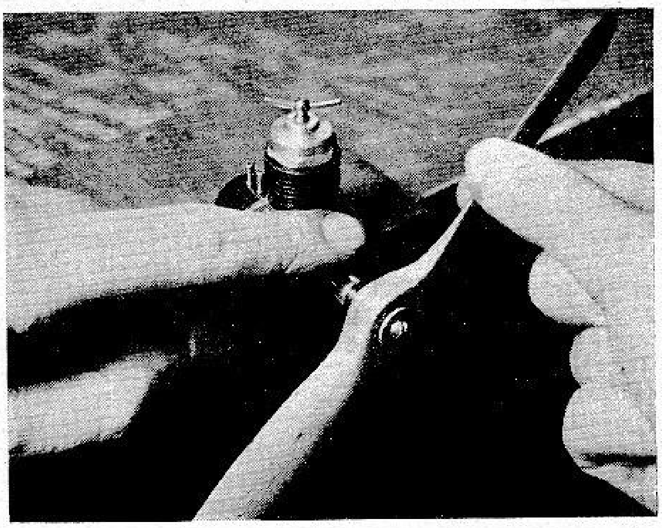


Fig. 7. "Sucking-in" prior to starting. The forefinger of the left hand covers the carburettor intake.

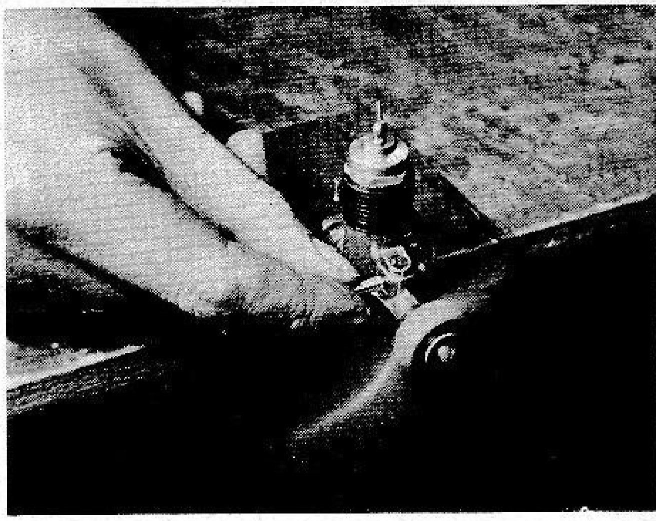


Fig. 9. Best performance is obtained with a relatively fine needle-valve opening.

If the engine still does not fire, increase the compression very gradually until it does. If, when the engine fires, it will not now continue to run, reduce the compression slowly. It is possible that, in the process of finding the starting compression, an excess of fuel has been drawn into the crankcase which is now being thrown up into the combustion chamber each time the engine fires. As it is used up, so the lever can be screwed down again until the engine is running satisfactorily.

The best performance is obtained with a relatively weak mixture and high compression. Therefore, we close the needle-valve gradually to obtain this. (Fig. 9.) It is less likely that an increase in compression will be required because, as the engine warms up, so the ignition point becomes automatically advanced for higher speed. It may, in fact, be necessary to slacken off the compression slightly. The necessity for this is indicated when the engine begins to slow up. Reduce the compression until a slight misfire is heard, then increase it again until the miss just disappears (Fig. 10.). Running the engine with excessive compression should be avoided.

In general, it should be remembered that the critical needle setting hardly alters with speed or load (i.e. depending on the propeller used), but that the compression adjustment does depend on these factors. Also, to get the engine to run slowly on any prop, all we have to do is slacken off the compression.

To conclude, here is a brief summary of the most common starting troubles and the remedies for them:

1. Engine starts but peters out again after a brief run. Cause: mixture too weak. Remedy: open needle-valve about one-quarter turn more, choke intake for a couple of flicks and re-start.

2. Engine slows down and/or oscillates back and forth or stops. Cause: mixture too rich and/or compression too high. Remedy: close needle-valve, reduce compression, flick prop to work off excess fuel, open needle-valve to lower setting and re-start.

3. Engine runs but misfires. Cause: insufficient compression. Remedy: increase compression.

4. Engine runs but with smoky and oily exhaust, irregularly and with reduced power. Cause: mixture too rich. Remedy: close needle valve slowly until running improves.

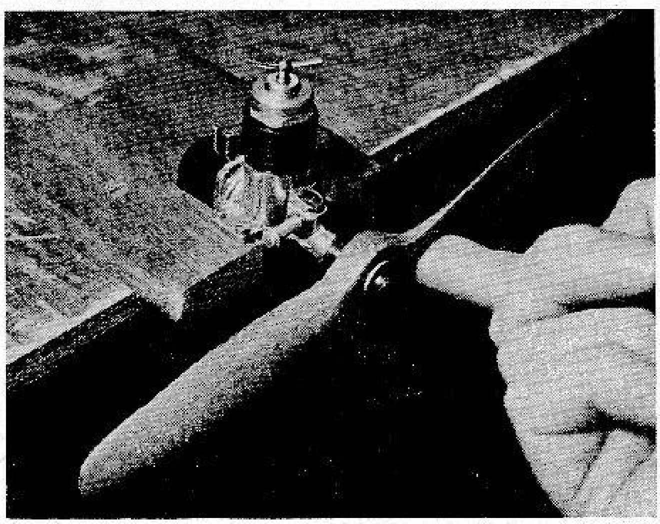


Fig. 8. To start, flick the propeller vigorously with the finger close to the hub.

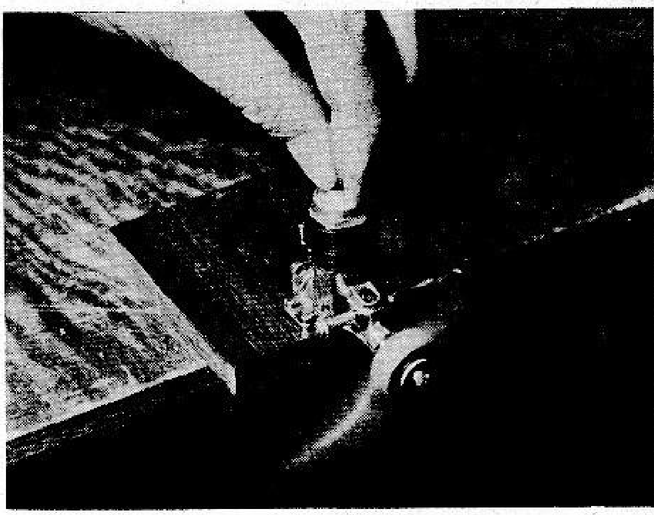
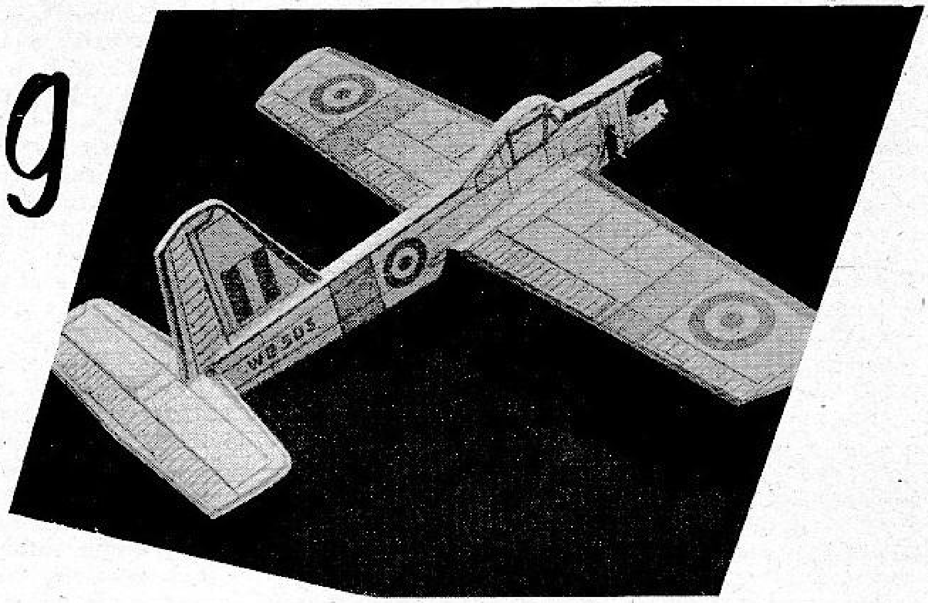


Fig. 10. A degree of speed adjustment is obtainable by turning the compression lever.

Building a C/Line Trainer



CHAPTER TEN

CONTROL-LINE flight is a development of the tethered flying of model aeroplanes which dates back to the late 1930s. In Britain, for example, r.t.p., or "round the pole," became quite popular as a means of flying small rubber models indoors, in halls or large clubrooms. The models were tethered with thread from a wing tip to a pole fixed in the centre of the room. Meanwhile, in America, Victor Stanzel introduced a system, which he called "G-Line," for flying power-driven models. In this, the line was attached to a pole held by the modeller. Then in 1940, Jim Walker, of the American-Junior Aircraft Co., announced "U-Control," which, instead of being merely a means of flying a model in a restricted space, gave, for the first time, actual *control* of the model via a linkage to the tail elevators.

In place of a single line, U-Control uses a pair of lines connected to a pivoted *control-plate* or *bellcrank*. Pulling on either one of these lines causes the bellcrank to swivel, moving, in turn, a push-pull rod coupled to it. The other end of this rod is linked to the elevator. The two lines, which can be of thread or nylon (small models) or thin steel wire (more powerful models), are secured to the top and bottom of a simple handle. Thus, by tilting the handle forwards or backwards (i.e. in much the same manner as the control-stick of a full-size aircraft) the model is made to climb or dive, to perform loops and to fly inverted. The normal radius for C/L flying is between 25 and 70 ft.—the longer line length being used only for fairly powerful models.

Virtually all C/L models use this, the Jim Walker patented "U-Control" system. The only noteworthy exception is the Stanzel "Mono-line" system favoured by some modellers—notably for speed models. In this, a single wire is used and control is effected through rotational movement of the wire. It is of especial value in speed flying, due to the lower drag of a single wire as opposed to two wires for

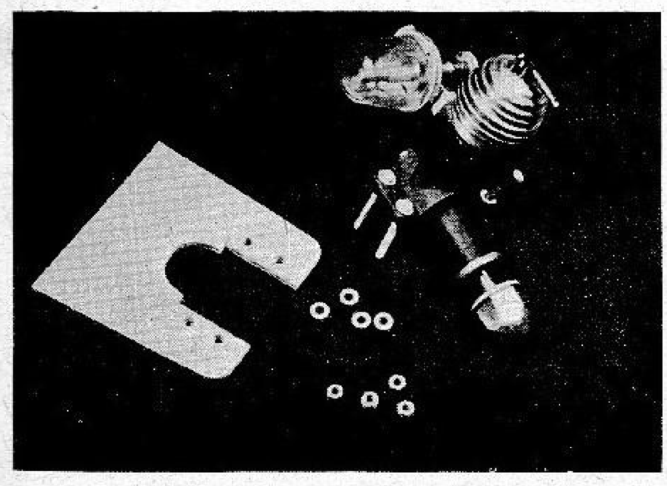


Fig. 1. Trim the engine mounting plate to fit the engine to be used and drill mounting holes accurately.

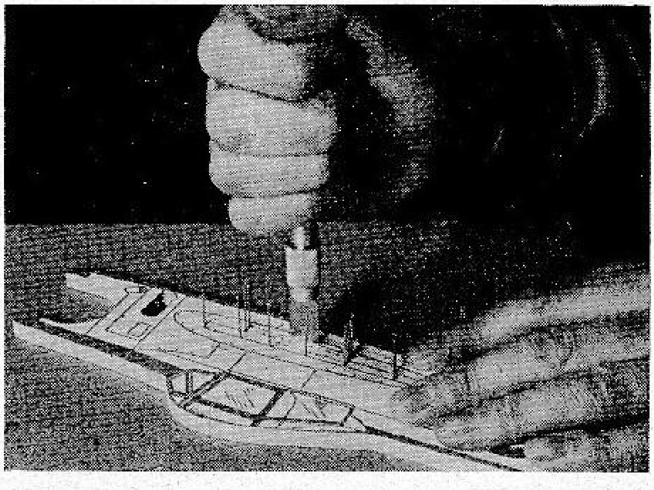


Fig. 2. Cut wing slot carefully, making sure that the tool is held perfectly upright.

the " U-Control " layout.

All C/L models are, of course, quite different from F/F models. For a given engine size, they are always much smaller and very much faster. Except in very specialised types, such as speeds models, it is also usual to find them resembling full-size aircraft more closely than most F/F models. They are always a good deal more solidly made than F/F models.

C/L flying is something that has to be learned. It takes a little practice to get used to controlling the model and the first time you try it, you will almost certainly lose control and crash the model once or twice. For this reason, it is very necessary that you first build a suitable *trainer* model, NOT an elaborate and highly vulnerable scale model, or a hot stunt job or speed model.

Fortunately, there are many suitable small trainer models for which kits are available. These are usually of the " profile " type with solid balsa wings and tail-units and are extremely easy and quick to build. Even if you have never constructed a model aeroplane before, you should have no difficulty in building up any of the kit models of this type.

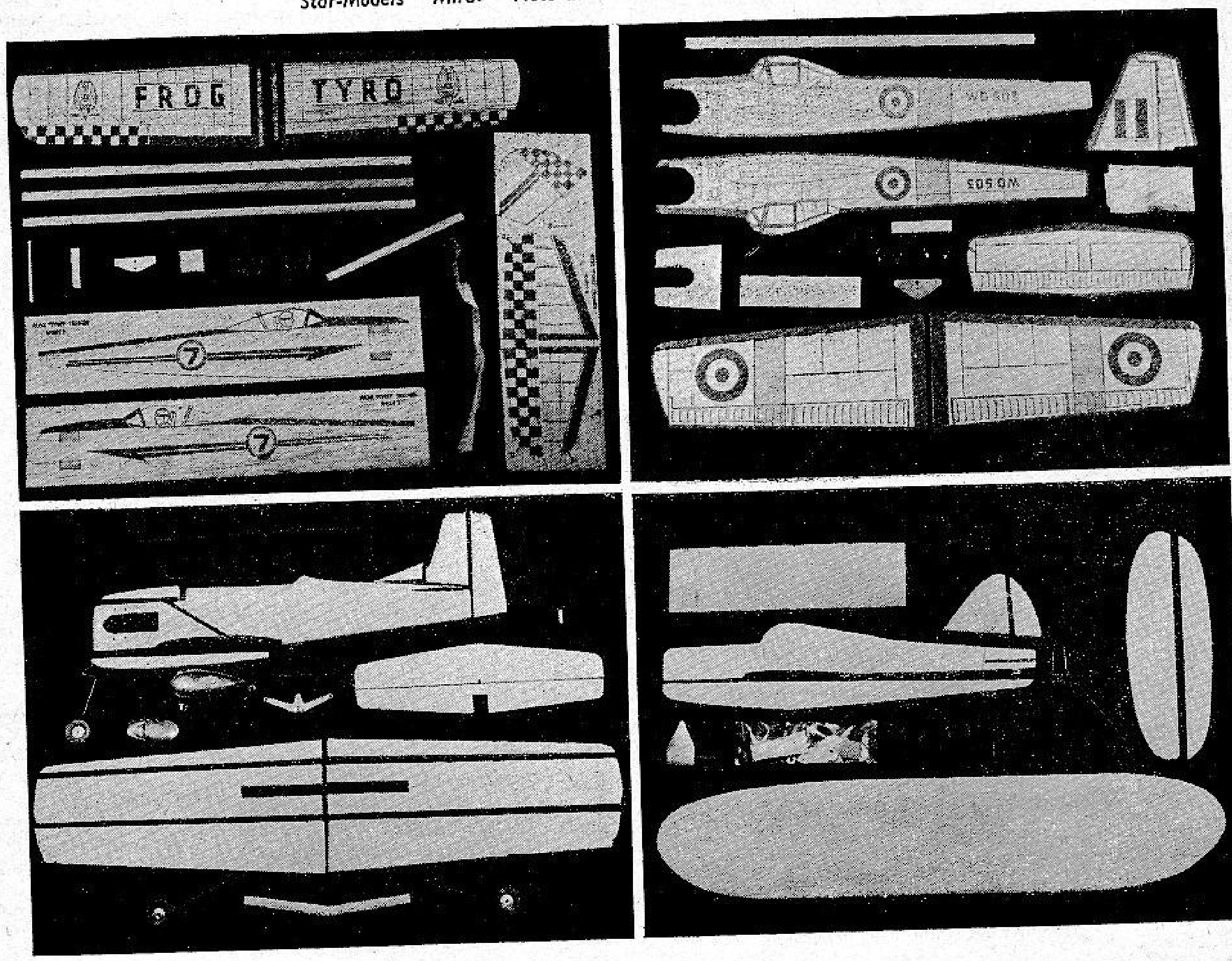
This type of model is offered by a number of manufacturers. Fig. 3 shows the contents of four such kits. The British made Frog *Tyro* and Veron Percival *Provost* are obtainable from any model shop in Britain and in many other countries also. In addition are shown the Jim Walker *Firebee*, popular in America, and a new German model, the *Mira*, which is now available to Continental modellers. Other popular profile models are the Keil-kraft *Champ* and the Jasco *Trojan*.

The model we have chosen for our photographic sequence is the Veron *Provost*. This, of course, is a semi-scale model based on the Percival *Provost* R.A.F. trainer aircraft. It has a span of 18 in. and is suitable for the up to 1/10 h.p. motors we recommended in chapter nine. The kit is of the prefabricated type, all parts being ready cut out and such items as the steel wire under-carriage struts are ready shaped. It is also " pre-decorated"—i.e. the balsa panels are printed with R.A.F. markings, etc., so that merely clear doping the finished model will suffice. If desired, of course, the model can, instead, be colour doped in the usual way.

This model differs from some other profile fuselage models in that the " fuselage," instead of being made from one piece of thick sheet balsa, consists of two ⅛ in. sheets with a simple outline frame between them. In most respects, however, the model is similar to others of this type and the following notes, while not applicable in any detail to other designs, can be regarded as covering models of this type in general.

The first thing to do is to check the plywood engine

Fig. 3. Four typical profile trainers. Left to right, top to bottom: Frog " Tyro," Veron " Provost," Jim Walker " Firebee " and Star-Models " Mira." Note the extensive prefabrication of these kits.



mounting plate against the engine to be used. The motor is, of course, side mounted and, if necessary, the slot in the mounting plate must be trimmed so as to fit the crankcase properly. We chose the Mills 75 motor to power the model and this entailed widening the slot slightly as shown in Fig. 1. At the same time, four bolt holes were bored, using a 3/32 in. drill. Make sure that you get the holes correctly aligned. The best way to do this is to first position the engine and mark one hole. Drill this, then fit the engine in position with a single bolt and nut and mark the other three.

Next, pin the two sides together temporarily and cut out the slots for the wing and undercarriage mounting. The best way to do this is to use a chisel point modelling tool and to first drive pins vertically through the two sides along the lines marking the wing slot. Make sure that the pins are vertical and in line. Using the pins as a guide, it is now a simple matter to cut straight through the two, using a tool such as the X-acto No. 5 handle with No. 18 chisel point blade. (Fig. 2.) Alternatively, a steel-backed " Ever-Ready " razor blade can be used if care is taken to ensure that it is held quite vertically.

The two side panels, still pinned together, may now be smoothed along their edges, top and bottom, with a sandpaper block, to ensure that they are identical.

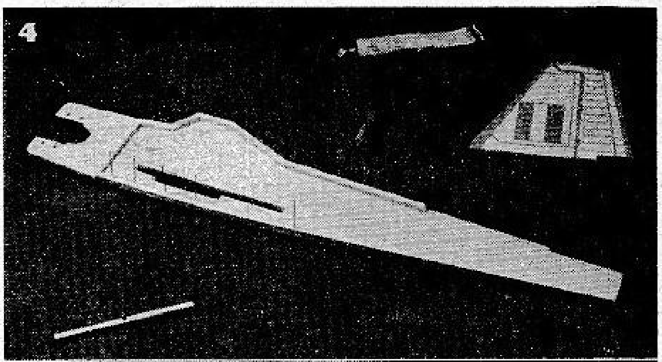
Unpin the two sides and lay the right (starboard) panel on the building board, printed side downwards. Position the plywood engine mounting on the side panel and then pre-cement both surfaces. While these are drying, pre-cement a length of $\frac{1}{8}$ square balsa on one edge and also pre-cement a border $\frac{1}{8}$ in. wide around the edge of the side panel. Always rub the cement well into the grain when pre-cementing.

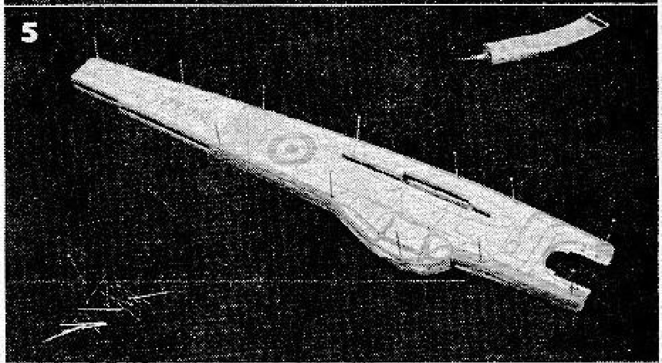
Coat the engine plate again with cement and press firmly into place on the side panel. Now add the $\frac{1}{8}$ square outline strips as shown, pinning the curved bottom strip in position. (Fig. 4.) Finally, add the second side (remembering, of course, to pre-cement bare wood surfaces) using pins to hold the panel securely in position while the cement hardens. (Fig. 5.)

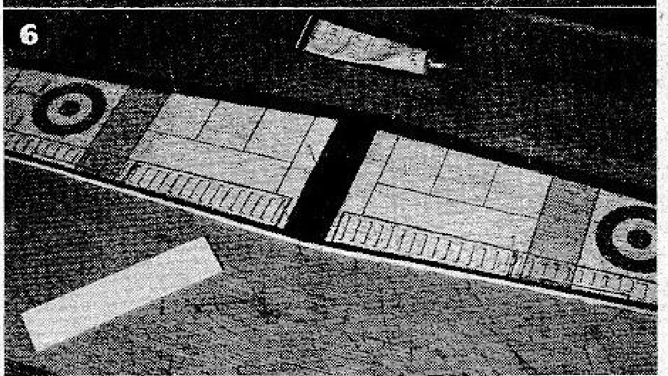
The wing is supplied in two panels which must be joined at the centre with the 4 in. $\times$ 1 in. plywood plate supplied. Liberally pre-cement the two adjoining edges and pin one wing panel flat on the building board. When the cement coating is dry, apply the second coat and firmly butt the second panel against the first, pinning this, too, to the building board as shown in Fig. 6.

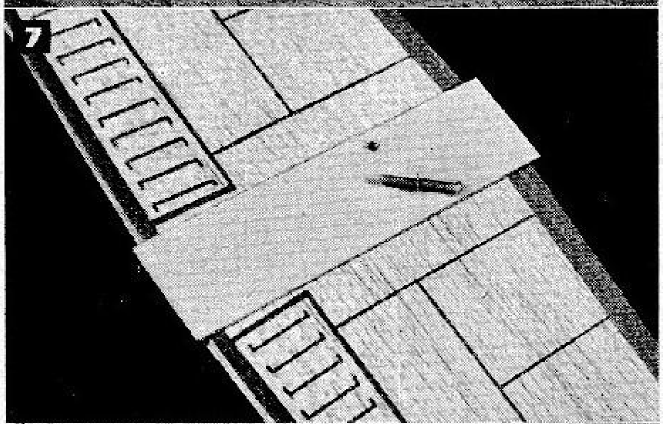
Before the ply plate or gusset is fitted, it should be drilled for the bellcrank pivot bolt and while the wing is drying, therefore, the other plywood fittings can be cut and drilled. These consist of two line-guides, an elevator horn and a small reinforcing plate for the bellcrank pivot bolt which is cemented to the lower surface of the wing. The two holes for the undercarriage fixing bolts can also be drilled at the same time. These are all seen in Fig. 8. Also, drill the pivot hole through the wing in the indicated position.

Liberally pre-cementing the two surfaces, fit the ply plate to the centre section of the wing and allow ample









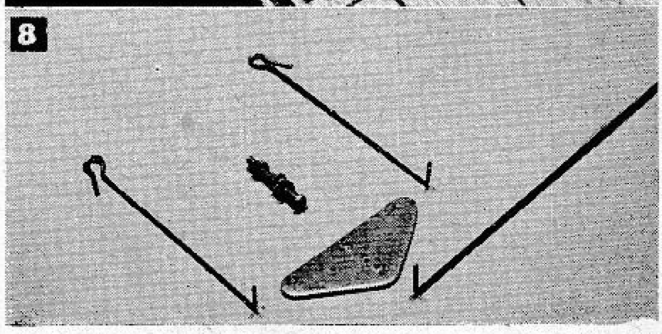


Fig. 4. Fit the motor plate and fuselage panel.

Fig. 5. Fit second side, pinning while cement dries.

Fig. 6. Butt joint wing panels at centre after pre-cementing edges liberally.

Fig 7. Firmly cement plywood centre section plate over wing joint. Align holes with bolt.

Fig. 8. Parts of the bellcrank assembly showing the two lead-out wires, pivot bolt, pushrod and control-plate.

time to dry before removing from the building board. Make sure that the pivot holes are correctly lined up by temporarily inserting the bellcrank bolt. (Fig. 7.) Then fit the small bottom ply plate and the two ply line guides to the wing tip.

The bellcrank components are seen in Fig. 8. Cement the wing in the fuselage slot, making sure that it is at right angles to the fuselage. Insert the push rod through the fuselage and engage the bent up end with the bell-crank, having previously fitted the two lead out wires to the latter. Now insert the pivot bolt through the wing from the top and secure it to the wing with a nut between the bellcrank and the bottom surface of the wing. Add a washer and nut so that the bellcrank is free to swivel but without wobbling about. Set this adjustment with a second nut locked against the first. The complete assembly can be seen in Fig. 9. It should be stressed here that the bellcrank must move absolutely freely. If the lead-out wires should tend to bind in the fuselage slot, trim away the wood at this point to allow unrestricted movement.

The next thing to do is to fit the undercarriage struts. This is a simple matter and is shown in Fig. 9. The wheels are retained with washers soldered on the ends of the axles, or special wheel retaining clips, obtainable at some model shops, can be used.

The tailplane should be cut cleanly along the hinge line with the aid of a straight-edge. Cut out the slot for the elevator horn also. The tailplane and elevator are connected with cloth hinges as shown in Fig. 10. Tape is supplied in most kits for this purpose. Our personal preference, however, is for silk or nylon hinges, as shown, so as to keep the control system as free as possible. The method of fitting the hinges will be evident from study of Figs. 10 and 11. After cementing them to the top surfaces as shown in Fig. 10, the tailplane and elevator are turned over and brought together with the hinges folded upwards. With the tailplane and elevator pinned down to the building board, the protruding ends of those hinges cemented to the upper surface of the tailplane are now cemented to the lower surface of the elevator, and vice-versa. The ply elevator horn is also cemented in position, using plenty of cement.

The tailplane is now fitted in position on the fuselage. (Fig. 12.) Before cementing it, however, check that, with the pushrod end inserted through the elevator horn, the elevator is level when the controls are neutral. You may find that the elevator is slightly " up " or " down." If so, the tailplane may be repositioned slightly, forward or backward, so as to correct this tendency.

Finally, divide the fin and rudder, again using a straight-edge, and securely cement the fin in the fuselage slot. (Fig. 13.) The rudder is cemented in position with an offset to the right—see heading photograph.

After lightly sandpapering any rough surfaces, such as the underside of the wing, the *Provost* only requires doping to finish it. We suggest two or three coats of banana-oil as very suitable. It must be understood that doping of some kind is essential, otherwise the model will be quickly ruined by oil, blown out of the exhaust.

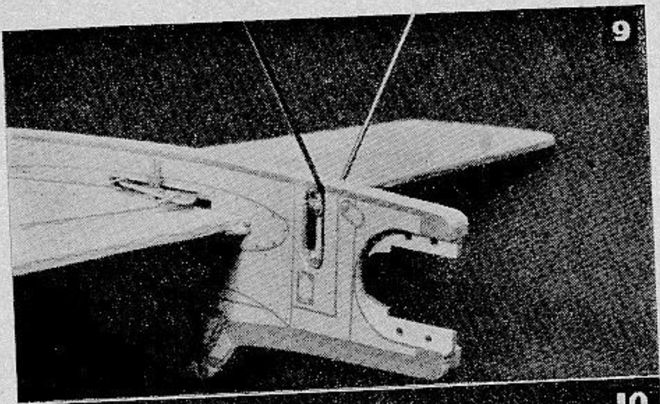

9

Fig. 9. The undercarriage legs are fixed with two bolts and nuts to the ply engine mounting plate.

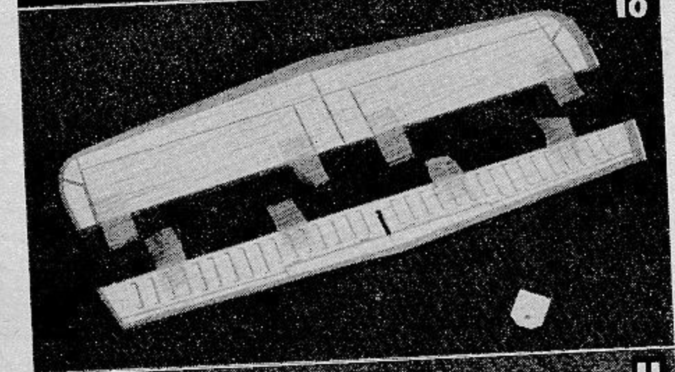

10

Fig. 10. Tailplane and elevator, showing hinges and elevator horn.

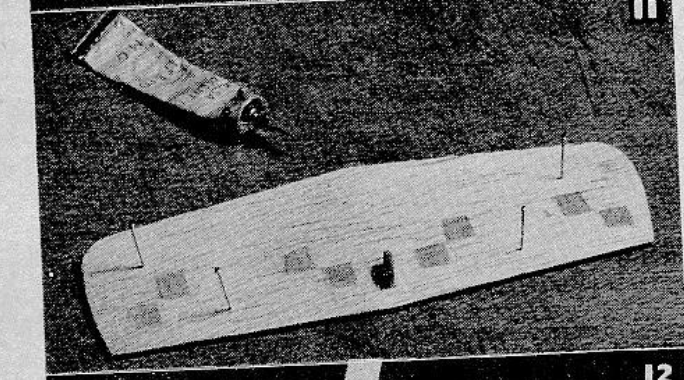

11

Fig. 11. The underside of the tailplane assembly showing how the hinges connect the elevator and tailplane.

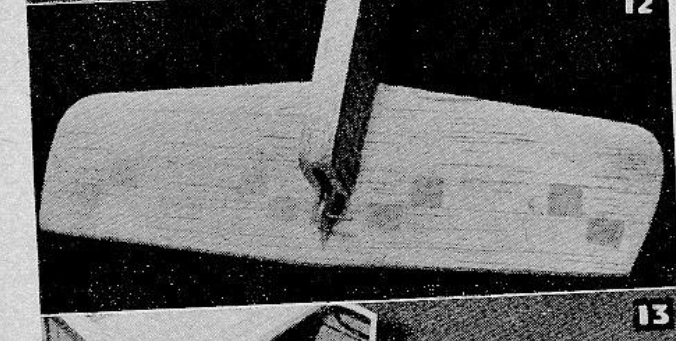

12

Fig. 12. Cement tailplane to fuselage, ensuring that elevator is level when bell-crank is centralised.


13

Fig. 13. Cement the fin in position, then fix rudder with offset.

Flying your C/L Trainer

Heading photo shows the completed Veron Provost and (left) another excellent C/L trainer, the Jasco Trojan

CHAPTER ELEVEN

MOST people, on first witnessing a control-line flight, want to ask the pilot : "Don't you get dizzy, turning round like that ?" The answer is yes, but only at first, when learning.

Most control-line models, apart from pure speed models and team racers, make one lap about every five seconds. This figure holds good for both large and small models because the bigger and faster machines are flown on proportionately longer lines. A useful indication of suitable line length is, in fact, "one foot per m.p.h.," e.g. 30 feet for a 30 m.p.h. model, 70 feet for a 70 m.p.h. model.

The majority of learners experience some dizziness at first, but after a few flights this is soon overcome. If dizziness appears to persist, make sure that you are not flying on lines that are too short, or against a background that is too close. Other rules for avoiding giddiness are (a) keep your eyes on the model constantly and (b) start off by making short flights of not more than four or five laps.

In the previous chapter we dealt with simple profile trainers, including the construction of a typical example, the Veron *Provost*, in which we used a Mills 75 Diesel.

Fig. 1 shows how the Mills 75 is installed in this model, utilising the existing fuel tank. The locknut securing the carburettor venturi is slackened and the entire carburettor unit and tank is then merely rotated so that the fuel bowl is vertical when the engine is side mounted. Note that the engine is installed with the cylinder to the right—i.e. the outside of the circle. This is most important, for the weight of the cylinder helps to balance the weight of the control-lines on the inside. Some models have a small lead counterweight built into the outer wing tip for this purpose.

In some other types of models, and when using an engine without a suitable integral fuel tank, a separate installation will have to be made. Fig. 2 shows such an installation. The model is a Jasco *Trojan* (another very simple profile trainer which can be highly recommended) powered by a German Taifun Hobby engine of 1 c.c. capacity. In this, a metal wedge-shaped fuel tank of the 15 c.c. Class A team-racing size is fitted to the fuselage by means of a sheet aluminium strap and two screws.

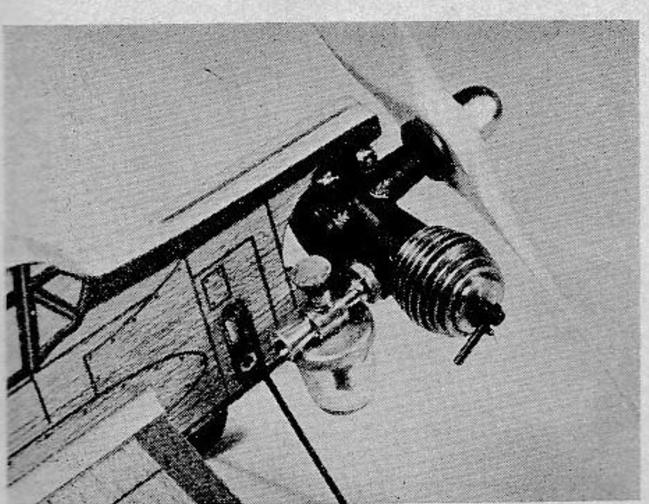


Fig. 1. How the Mills 75 is installed in the Provost using the standard Mills tank turned through 90 degrees.

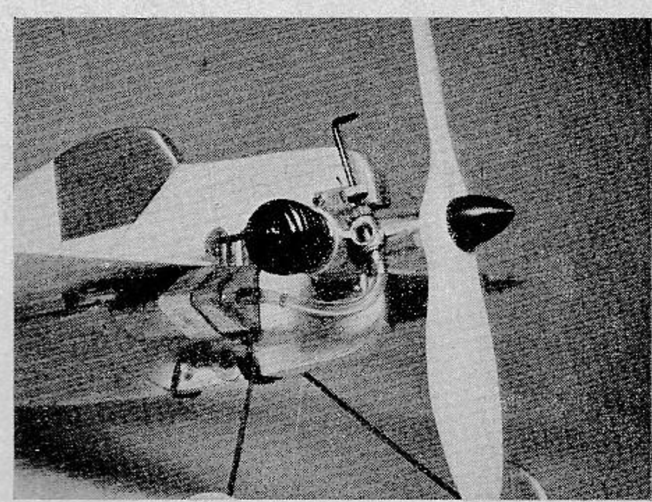


Fig. 2. A typical installation where a separate tank is used. Model is the Jasco Trojan fitted with a 15 c.c. teamracer tank.

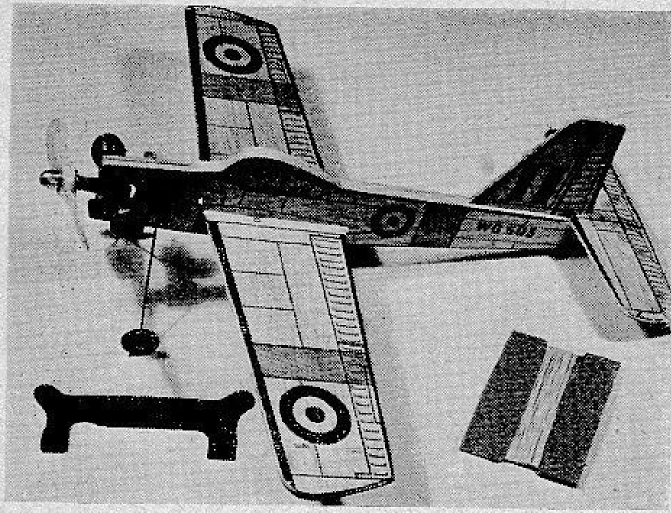


Fig. 3. The Provost trainer, as detailed in our previous chapter, ready to fly. Shown also is a simple control handle made from sheet fibre.

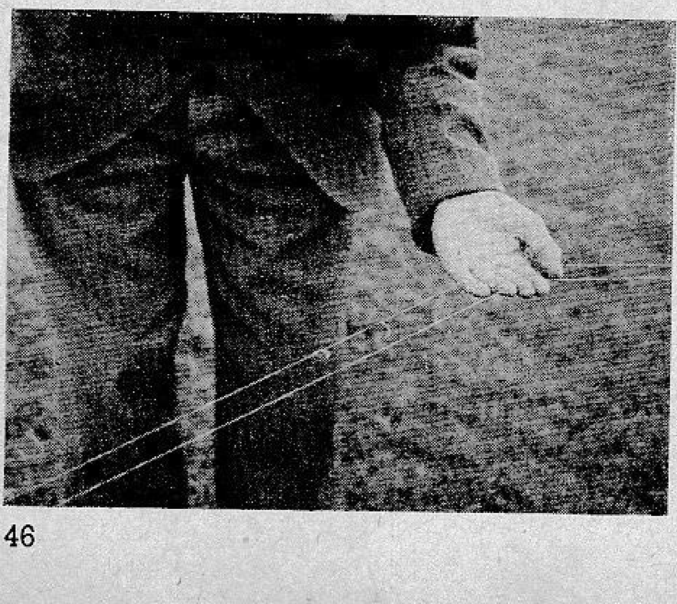
Before fitting the engine, make quite sure that all woodwork has been adequately doped. If you have built the *Provost* and elect to leave it in its natural printed wood colours, it must have at least two or three coats of No. 1 (thick) banana-oil. Brush the dope on liberally and well into all corners and joints.

If the model is to be colour doped, it should first be treated with two coats of "sanding sealer" to fill the grain, which, after rubbing down with fine sandpaper, can be followed by two thinned coats of coloured dope, put on with a soft sable brush.

The ideal final protection against deterioration by fuel is a fuelproof varnish. This, while not strictly necessary with diesel engined models, is essential where a glowplug engine is being used, on account of the tendency for methyl-alcohol based glowplug fuels to dissolve cellulose based dopes. Most of these "fuelproofers," as they are popularly called, are sold with a small, separate bottle of "hardener" which is added to the proofer just before brushing it on to the model.

Proofer is much more economical than dope and only a very little is needed to cover a complete model. Therefore, you will need to mix only a small quantity at a time.

Fig. 4. Always check the condition of the control lines before flying the model. They must not be frayed or weakened.



Pour a little of the varnish into a small container—the lid of a dope jar will do—and stir in not less than 10 per cent. hardener. You can safely use more hardener than this, but don't try to cut the amount down because, if you do, the varnish may remain tacky indefinitely and make the model a terrible mess.

In the United States, fuelproof varnishes have largely been superseded by special fuel-resistant butyrate dopes. A fuelproof coloured dope of this type is now also available in Britain. It is known as "A.F.P." and is made by Messrs. Hamilton Model Supplies.

If possible, all doping, etc., should be completed at least a day before you intend to fly the model. This will give the finish plenty of time to harden before handling and fitting the engine, etc.

The engine is, of course, mounted with small machine screws and nuts. It is preferable, also, to have small washers under all screw-heads and nuts and, to prevent the possibility of the nuts working loose with vibration, it is advisable either to use a second nut on each bolt, locked against the first, or to use a special type of "shake-proof" nut, such as the "Oddie" or Simmonds "stop-nut."

Fig. 5. With the aid of a helper, the pilot should check the controls for free movement and correct centring.

As regards propellers, the beginner cannot do better than to purchase one of the flexible plastic types, such as the Frog, "Tru-flex" or E.D. plastic pattern. Unlike wooden props, which break easily, these flexible airscrews will survive innumerable crashes and hard landings. For the Mills 75, we chose an E.D. $6\frac{1}{2} \times 7$ prop. A 7×6 prop would be equally suitable.

Before you can fly your first C/L model, you must, of course, have a C/L handle and lines. You can purchase a good handle from your model shop which will also serve for all your future C/L models. Alternatively, you can make one very cheaply from plywood or fibre. A suitable shape is shown in Fig. 3. The distance between the two control-lines where they are attached to the handle should be approximately 4 in. Shape, or otherwise mark, the handle so that the top is easily distinguished from the bottom.

The type of control-line used today depends very much on the model being flown and, for most types, thin steel control-lines are used. These have two advantages. Firstly, being thinner, for equivalent strength, than any

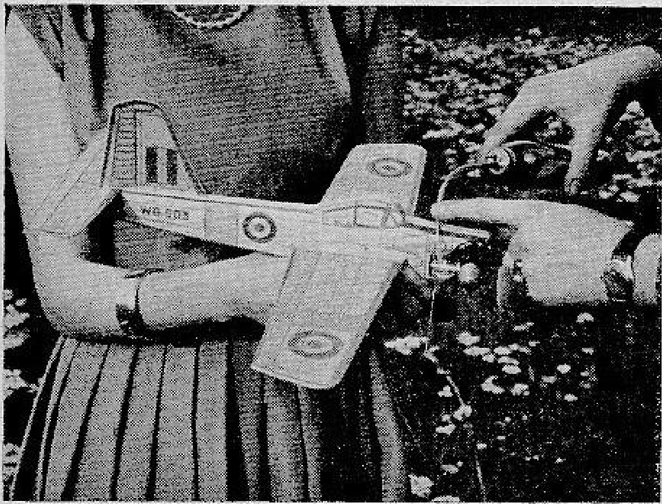


Fig. 6. Do not overfill the fuel tank for your first few flights. Have sufficient only for three or four laps.

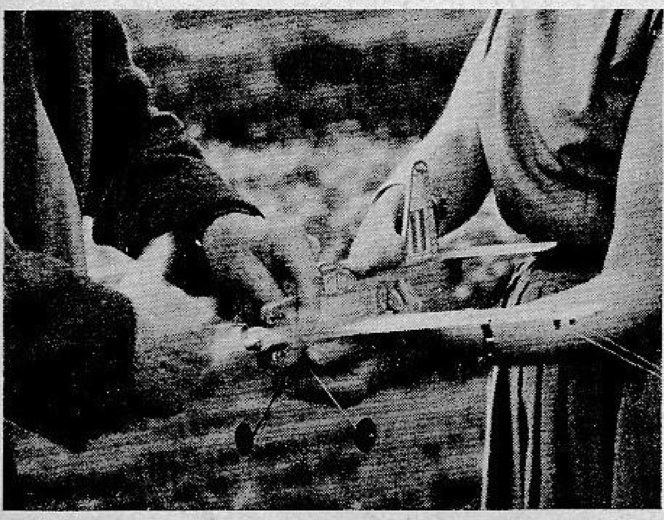
other material, they present minimum drag, thus permitting the highest performance. Secondly, for aerobatic work, they still maintain control (by sliding over each other) after being twisted together by a succession of loops and other manoeuvres.

For small trainer models, however, a thin fishing line or strong carpet-thread is quite adequate. Heavy lines should be avoided. The length should not normally be less than 25 feet. In calm weather, this can be increased up to 30-35 feet.

The thing to remember about line length is that it has to be a compromise. If the lines are short, the model laps much faster, is closer to you and seems even faster and you have to think and act more quickly. Long lines, on the other hand, give you a more leisurely flight, but also a tendency towards less positive control due to reduced line tension.

Line tension is of the utmost importance. If the lines become slack, the elevator control will become ineffective and, if the model is high and sideslips towards the centre of the circle, a crash is then a certainty. Most C/L models, with the exception of speed models, therefore incorporate certain features designed to augment the

Fig. 7. When starting up, your helper should hold the model firmly. The wearing of a wristwatch is not recommended, however, because of fuel blown back by the slipstream.



action of centrifugal force in keeping the model pulling outwards.

The most common of these features is the offset rudder. Another most effective system is the positioning of the bellcrank pivot behind the centre of gravity. Some designers also offset the engine thrustline outwards.

Other safety features sometimes used are weighting the outer side (as previously mentioned) and making the inner wing panel of slightly larger area than the outer wing. These do not rudder the machine outwards but, instead, tend to bank it away from the centre of the circle if line tension should be lost.

When you are ready to make your first attempt at C/L flying, try to find a helper who is familiar with control-liners. If he is an experienced C/L flier, let him check over your model. In fact, if you have seen him in action and have confidence in his ability, it is a good idea to get him to test fly your model. Probably the first thing he will do is to check your controls by working the leadouts back and forth. These should move absolutely freely.

One other point. Don't attempt to learn to fly on a

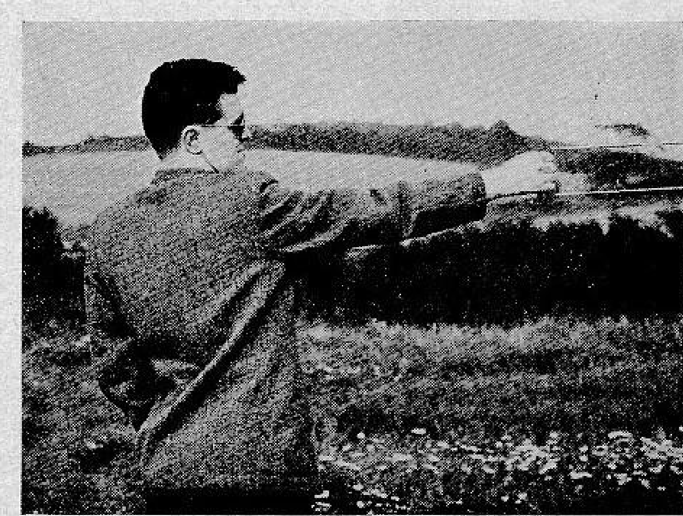


Fig. 8. The arm position generally recommended when learning. Correction of climbing or diving is made by moving the arm down or up from the shoulder.

windy day. Wait for calm conditions and, for preference, pick a field of long grass or soft weeds.

Lay out your control-lines, attaching them securely to the handle and to the leadout wires from the bellcrank on the model. Make a habit of inspecting the lines before use to ensure that they are not frayed or otherwise weakened (Fig. 4).

Now get your helper to hold the model aloft. Take up the handle and try the control movement (Fig. 5). Note how the elevator rises and falls as you move the handle. As already mentioned, the controls must move smoothly and freely. With the handle held upright, the elevator should be neutral, i.e. level and in line with the tailplane. Adjust the line length until this is so.

The lines should be laid out so that the take-off or launch is made *downwind*. If the launch is made upwind, like a F/F model, there is a danger of the model climbing too high and with too little speed during the first quarter of the circuit and then being blown inwards by the wind as it turns side on.

Lay the handle down where you can easily see it and prepare to start up. For the first few flights it is not

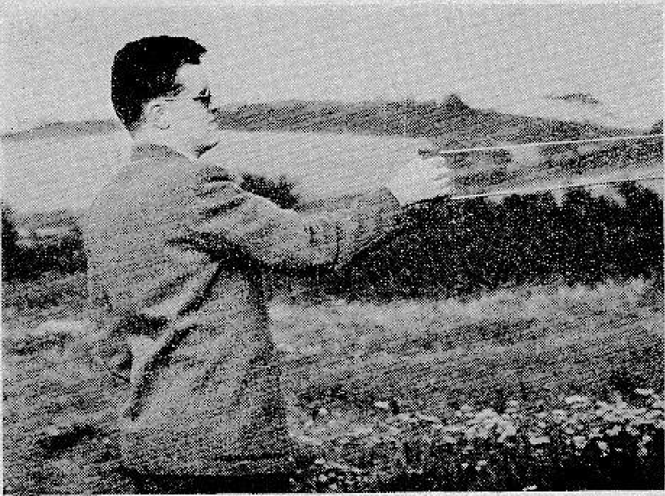


Fig. 9. A more relaxed attitude which is naturally acquired when one has mastered the art of holding the model on a steady course.

advisable to have too much fuel in the tank: enough for one minute's running time is more than enough and will allow you 30-40 seconds to adjust the running of the engine and to get back to the handle and settle yourself for the take-off. You should not attempt to fly the model for more than 15-20 seconds for each of your initial flights. *Make sure that you are holding the handle the right way up.*

The simple fact that you must keep before you at this time is that the model, even though it is only a simple trainer, is quite sensitive to the movement of the elevators. A slight movement of the wrist (Fig. 10) and the model will immediately climb or dive. Until you are used to C/L flying, your anticipation will be slow, with the result that you will tend to *over-correct, too late.* You may quickly find yourself in trouble, with the model going all over the sky and your responses quite unable to keep up with it. There is only one sequel to this. Seconds later the model will dive straight into the ground.

The first thing to do to avoid this kind of trouble is to keep your arm, and especially your wrist, quite stiff and to control the model by movement of the arm from the shoulder only (Fig. 8). When you start off, do not forget this. Keep your arm stretched out straight in front of you and slightly in front of the model. During these first few flights, try only to keep the model *level.* If it begins to sink too near to the ground, raise the whole arm a few inches and the model will come up again. If it climbs too high, bring your arm down.

Fig. 10 The tendency to attempt to control the model by wrist movements must be strictly avoided by the beginner.

Your *only* concern during these first few flights should be with letting the model fly a steady, level course. As yet, you are really quite unfitted to *control* the model. You must first get used to the *feel* of the model as it flies round on the end of the lines you are holding. Forget all about "stunts"—even those of the mildest type. These will come later easily enough, but only when you are able to keep pace with, and in fact anticipate, the model, so that you are, in effect, controlling the model instinctively.

You can either take the model off the ground (in which case you need a really smooth and level take-off strip) or you can get your helper to hand-launch it for you (Fig. 11). In either case, the lines must be taut and the model directed straight out at a tangent to the circle and not *into* the circle. Your helper should, of course, always await a pre-arranged signal from you to indicate that you are quite ready, before he releases the model.

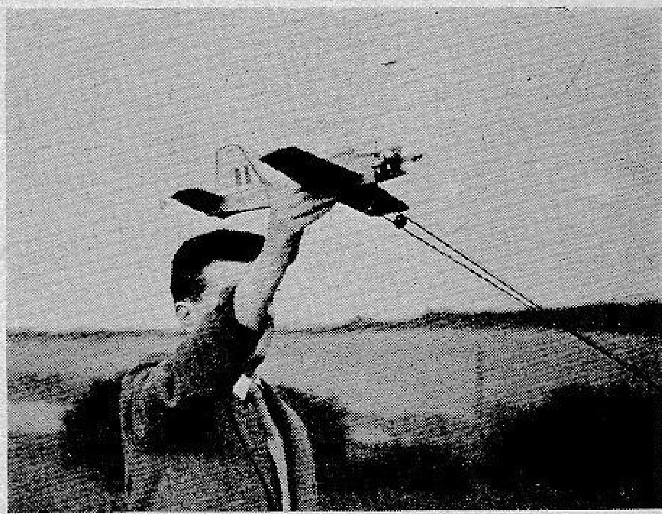


Fig. 11. Hand launching. The model must be launched downwind and at a tangent to the circle so that the lines are kept taut.

If while you are flying the machine, you feel the line tension slacken, take a quick pace or two backwards. If done promptly this will prevent loss of control. *Do not* merely pull the handle towards you or back over your shoulder.

Incidentally, an excellent way to learn to fly a C/L model is to have an experienced "pilot" in the centre of the circle with you. He can take the model off, transfer the handle to you when the model is level and take over again if you get into difficulties.

When you go flying, don't forget the accessories. Nothing is more frustrating than to find that you have forgotten some small tool and cannot get on without it. Remember to take a prop spanner or tommy-bar, screwdriver, pliers and a piece of rag. If you add a tube of cement, some pins and a small roll of cellulose tape, you may also be able to effect a quick repair on the spot if you have the misfortune to damage the model.

Finally, two safety "don'ts" concerning C/L flying in general. Firstly, don't fly anywhere where spectators cannot be warned or otherwise controlled. Secondly, never fly near overhead power cables.