Air Trails MODEL ANNUAL *for 1944*

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Over 100 Plans and Features! POSTWAR MODELS · PLANBOOK OF FAMOUS PLANES · PLASTIC MODELS · CUTAWAY DRAWINGS · DESIGN!

THE WAKEFIELD TROPHY

1928	ENGLAND	NEWELL	52.8	seconds
1929	ENGLAND	BULLOCK	70.4	"
1930	U. S. A.	EHRHARDT	155.0	"
1931	U. S. A	EHRHARDT	234.0	"
1932	U. S. A.	LIGHT	477.4	"
1933	ENGLAND	KENWORTHY	321.0	"
1934	ENGLAND	ALLMAN	111.8	"
1935	U. S. A.	LIGHT	146.6	"
1936	ENGLAND	JUDGE	249.0	"
1937	FRANCE	FILLON	253.2	"
1938	U. S. A.	CAHILL	654.0	"
1939	U. S. A.	KORDA	950.2	"

THE tale of this internationally famous model-airplane trophy is particularly interesting in these troubled war times. Lord Wakefield, of England, who has since passed away, thought, some twenty years ago, what a fine thing it would be to promote friendly competition among model builders of all countries. The perpetual trophy he donated soon acquired the prestige of the famed America's cup for which the world's finest yachtsmen competed. Significant, perhaps, was the fact that Germany, and countries now allied with her, seldom took part. On the other hand, England developed the keenest rivalry with us; and models mailed from far-off Australia, South Africa, and New Zealand were proxy-flown by expert builders at the contest.

Teams consisted of six men, finalists from their own country's nationals or elimination contests. The winning country played host the following year. The models were designed according to special rules. Rubber-powered, these models had approximately 200 square inches of wing area and a minimum weight of eight ounces to the square foot of wing area. Adherence to the rules was strictly enforced. So

(Turn to back inside cover)

Air Trails
MODEL ANNUAL
for 1944

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SPECIAL FEATURES

CONTROL-LINE FLYING

DESIGN

PLANBOOK

GLIDERS

ENGINES

FREE FLIGHT GAS MODELS

CONSTRUCTION

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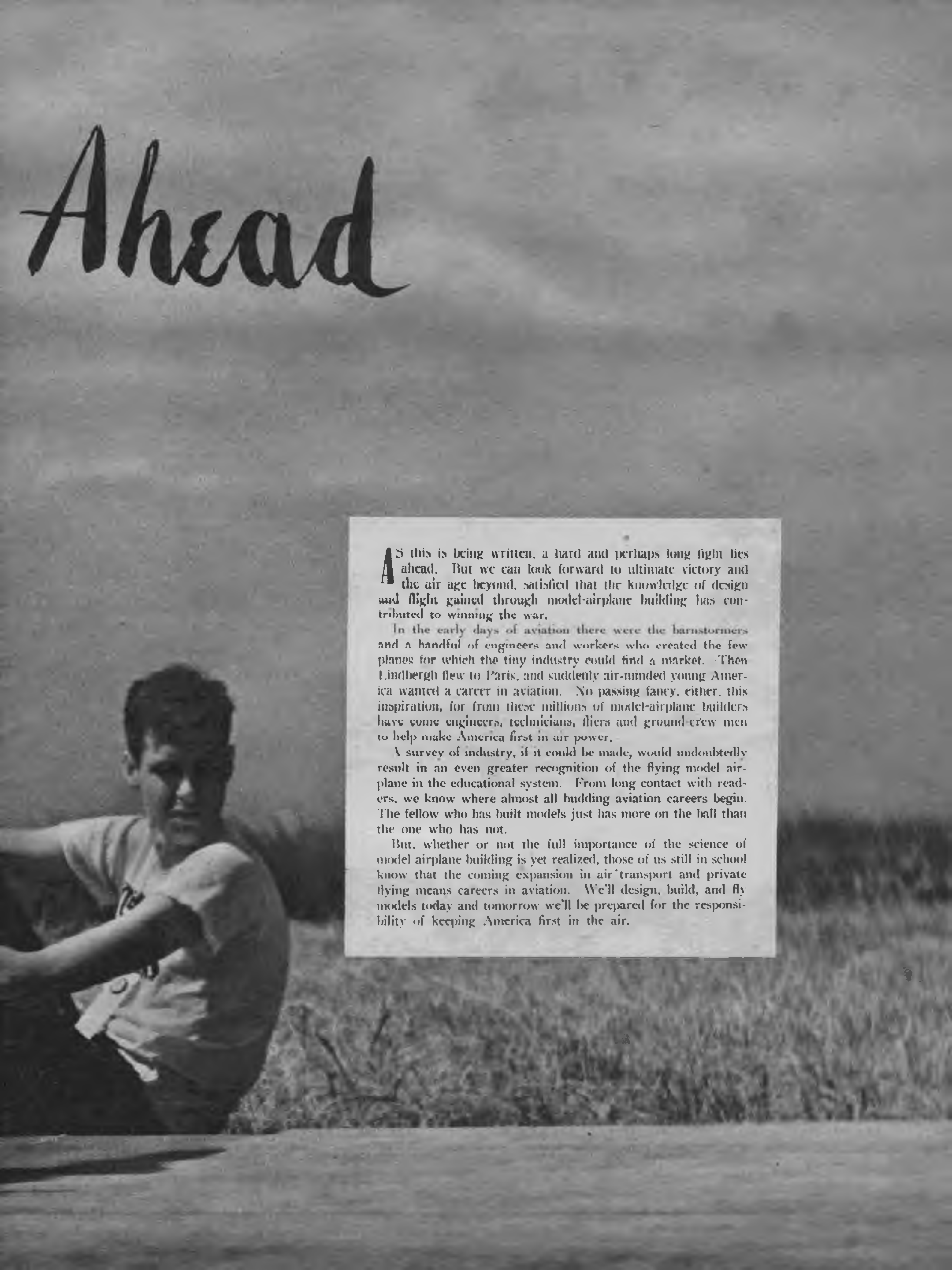
Looking

Ahead



AS this is being written, a hard and perhaps long fight lies ahead. But we can look forward to ultimate victory and the air age beyond, satisfied that the knowledge of design and flight gained through model-airplane building has contributed to winning the war.

In the early days of aviation there were the barnstormers and a handful of engineers and workers who created the few planes for which the tiny industry could find a market. Then Lindbergh flew to Paris, and suddenly air-minded young America wanted a career in aviation. No passing fancy, either, this inspiration, for from these millions of model-airplane builders have come engineers, technicians, fliers and ground-crew men to help make America first in air power.

A survey of industry, if it could be made, would undoubtedly result in an even greater recognition of the flying model airplane in the educational system. From long contact with readers, we know where almost all budding aviation careers begin. The fellow who has built models just has more on the ball than the one who has not.

But, whether or not the full importance of the science of model airplane building is yet realized, those of us still in school know that the coming expansion in air transport and private flying means careers in aviation. We'll design, build, and fly models today and tomorrow we'll be prepared for the responsibility of keeping America first in the air.

YOUR POSTWAR

WHEN thousands of model builders now with the armed forces return to civil life, model aviation should experience a boom that will dwarf the busy 1938-1940 period. Joined by the younger generation of the postwar period, who will be more air-minded than ever, these model fans should vastly outnumber those of any period in the past. A wider range of age groups, resulting from more grownups being unwilling to outgrow the hobby, should contribute to a general recognition of model aviation after the war.

We are told that great changes and improvements are to take place as a result of the war. Just how our hobby will be affected makes for interesting speculation.

Your postwar model should be as new and thrilling as the helicopter. It will be a thing of beauty, made by new methods and materials and sporting technical features mention of which now sounds like pipe-dreaming. It will be a spectacular flier yet sturdy beyond anything yet seen. War accelerates technical progress, it has been said, but more than that the peace that comes after opens up new vistas of thinking and engenders ideas that might have been years aborning under a matter-of-fact existence. The science of model aeronautics is on the threshold of new features in design and construction that even now may be surmised.

What will the model plane of the future look like? Suppose we think of it in terms of design, construction, materials, and technical features. We will go way out on a limb and predict that the pylon will be dead! Your future gas buggy will bear an interesting and realistic relationship to its full-scale brothers, both in appearance and manner of flying. We offer this prophecy because we think the current kind of rules that made for monstrosities like Pencil Bombers—admittedly the finest "zip-and-dip" that can be devised, but doomed like that other scientific marvel, the "dodo" indoor model—will give way to rules that place emphasis on worthier factors by stressing flight efficiency. Streamlining will have new meaning; skin friction will be something you do something about, rather than talk about; contra-rotating propellers and retractable landing gears of marvelously new and perfected design will be *musts*.

The future high-performance contest plane will have a large wing span and high aspect ratio, carefully worked-out wing section, properly arranged aerodynamic factors, the wing parasoled, the center of lateral area on a level with the center of gravity—that is, the fuselage side area should extend down well below the center of gravity and the thrust line slightly above the center of gravity to give a long, steady glide without stalling. Large tail areas also are indicated. Model designs that at present appear fantastic may come into common use, possibly flying wings. Rubber-powered planes give little promise of radical changes, especially fuselage types.

Unquestionably, structure will be designed with an eye for convenience of operation on the field. Instead of building planes as a single integral unit, builders without doubt will build them in small units that can be quickly and conveniently assembled or replaced when damaged.

Construction has limitless possibilities for speculation. Since we have had such surprising success with substitute materials, will any of these be popular after the war?

Greater demand should justify the development of specialized plastic materials for model use. Possibly of a cellulose nature,

MODEL By Charles H. Grant

MODELS WILL BE MORE REALISTIC IN APPEARANCE AND IN FLIGHT; MAY FEATURE THINGS LIKE CONTRA-ROTATING PROPS AND PLASTIC CONSTRUCTION.

these parts would be uniform light, impervious to moisture; could be cut, shaped and fastened with model cement (or possibly some new super adhesive). Various extruded sections, including tubes, angles, boxes, I sections, special leading and trailing-edge parts, et cetera, would simplify model construction. These parts might be heated for bending to necessary shape, after which they would regain their initial stiffness. Complete floats (remember the "Silver Ace" models of ten years back?) or fuselage half shells, available in a variety of shapes and sizes could be moderately priced and should certainly speed assembly.

Efficient plastic propellers, already on the market, could include rubber-model types of two and three blades. Or, after the manner of Plexiglass, the propeller blank, flat, could be heated and shaped to desired pitch.

A completely finished propeller-folding and rubber-tensioner mechanism, perhaps made of magnesium and designed to be fitted with wooden or plastic blades, would no doubt find a ready market.

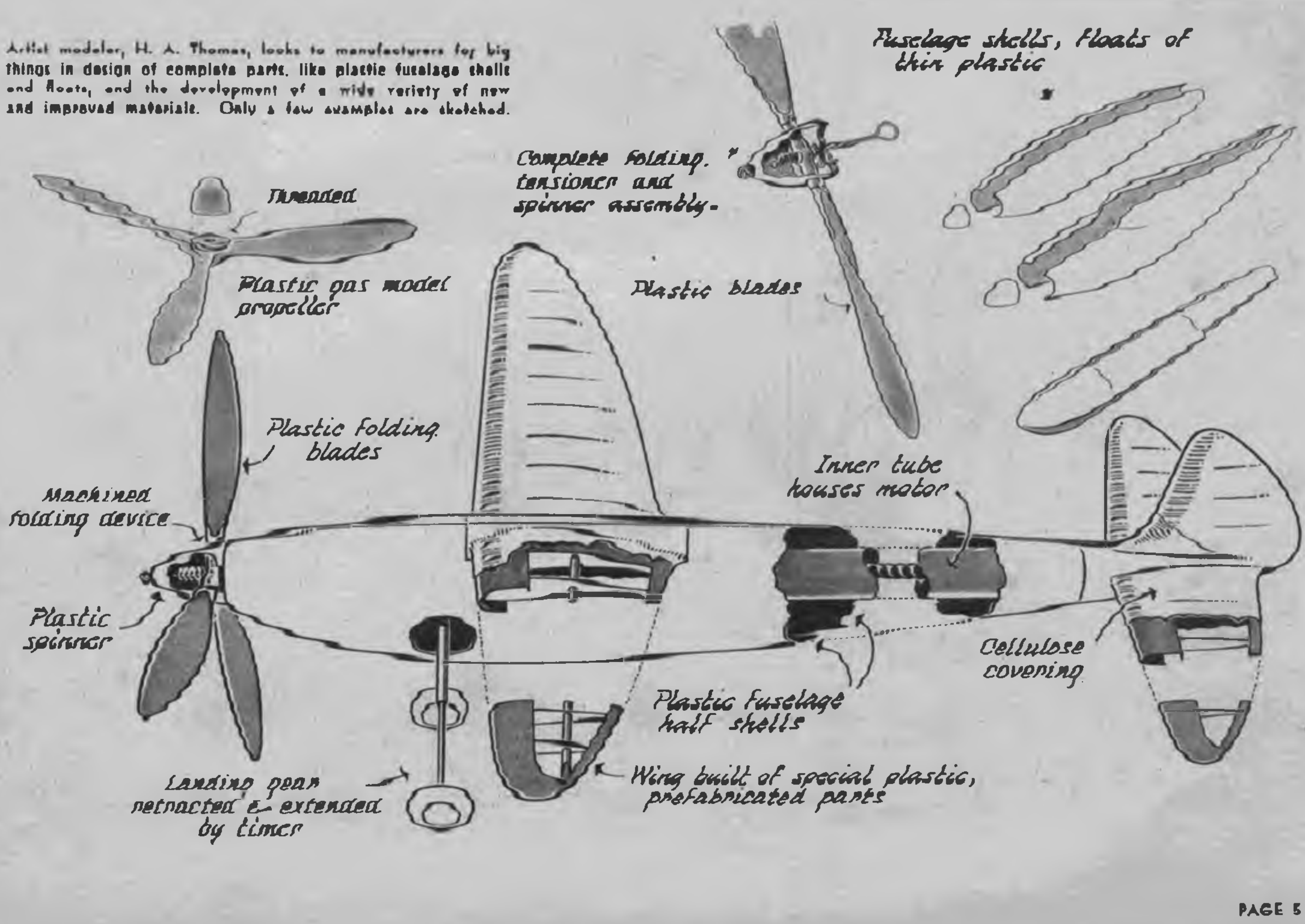
Covering materials might include refinements of the basic "Plane-film" and "Mirror-film" ideas. These, requiring no dope but only application of heat for necessary tautness, might be made slightly elastic to more easily cover compound curves such as wing fairings.

Various strips and sheets of pine, bass, balsa and other woods will always be important model material. Specially prepared paper or cardboard parts, with their advantage of fast and easy assembly, may also be frequently used.

War developments will surely improve the already promising applications of radio control to model aircraft. Complete transmitting and receiving units, more compact and efficient, should be available at more reasonable cost sometime after the war.

Familiar model airplane construction has followed the wood-and-fabric style of early aircraft. Why can't we expect construction after the war to be brought up to date with smooth, skin-stressed covering of plastic or some composite material which will be light and flexible, possibly impregnated with color? To be used throughout the structure, this material should be capable of being heated and shaped over forms to compound curves.

Increased numbers of model fans of all ages; a share in aviation training in the schools; modernized, popular rules; new designs, materials and construction can all be anticipated after the war, when model aviation should experience a tremendous boom.



Artist modeler, H. A. Thomas, looks to manufacturers for big things in design of complete parts, like plastic fuselage shells and floats, and the development of a wide variety of new and improved materials. Only a few examples are sketched.

YOUR POSTWAR MODEL

A Rubber-powered models give little promise of radical change, especially fuselage jobs. Stick models may prove the exception, as present types are unstable in some respects. The model sketched has a fin below the wing mount, which improves its spiral stability. Better rubber would help improve performance.

B This is not a designer's nightmare, but the author's conception of how the old-time twin-pusher design might appear in modern dress. Twin props, possibly plastic, would eliminate torque and give a terrific skyrocketing climb; while the glide would be improved due to the rubber motors being inclosed in prefabricate l tubes.

C Future gas models will have large wing spans, high aspect ratios, and carefully worked out wing sections. Improved engines, and new construction and covering materials, will allow the designer a broader scope. More attention will be given to designing models in units so that, in case of crack-up, replacements can be made.

D Seeking the ultimate in aerodynamic efficiency, model builders will overcome stability problems and develop successful flying wings. Retractable landing gears, inclosed motors with extension-shaft-driven props (perhaps even co-axial), will be the features of the more outstanding designs. Don't overlook jet propulsion.

At the last great Nationals in Chicago, 1940. That year Struck's New Ruler, a non-kit model, took the country by storm. Realistic, its neat lines and high performance made it popular. Today, the rules handicap anything that is not a stick gas model. Note cockpit in this New Ruler, in the foreground.

One of the first (1933) gas models in Jersey—by Jimmy Condon, above, Al Huber, and one other. Here Condon is ready to pull ignition switch—in case.

LOOKING

At Lake Hopatcong, N. J., in 1939, was held the first gas-model seaplane meet: it was won by Sal Taibi. A good time and many a dunking was had by all.

Leo Weiss was ahead of his time. With a fully planked, streamlined model he took first place in the 1935 Nationals, St. Louis; he took the Texaco Trophy.

Henry Struck, the present Nationals champion, was the greatest of them all. He would fly even scale models like this old French Caudron out of sight.

Remember the Junior Birdmen? John P. Lovett, of their Atlanta Wing, won a meet back when with this twin-pusher, an excellent type—now almost extinct.

In 1939, just before war, Bob Copeland, England, flew this streamliner at the Wakefield Trophy finals, Bendix, N. J. Dick Korda won with 44-minute flight.

BACK

In 1938 all of Little Rock, thanks to an old-timer, Sadler, built low-wings; thereby disproving some theories. Here is John Worthen with one interesting ship.

Looking back but a few months to a Long Island contest, we find Al Paddochi with a fine semiscale type of U-control gassie. Ship had workable wing flaps.

Ah, what do we have here, zombis? Nope, just indoor model builders doing their superscientific stuff in Grosse Isle airship dock, Detroit, '38 Nationals.

Elbert Weathers confounded the 1938 rules makers with his Mystery Man, using take-off dolly instead of regular undercarriage. He was burned at the stake.

Vernon Boehle—Spitfire pilot—caused a commotion in 1936 Nationals with this 15-foot gassie floater, taking advantage of loophole in wing-area rule.

Control line Flying

THE guy who used to amuse himself (and usually his friends) by swinging a pail of water over his head now spends his free moments in control-line flying. He was joined in this phase of the modeling hobby by members of that sorrowful group of builders who were always losing ships, by others who craved flight speed for their jobs, and by some unlucky modelers who had not the space for free-flight experiments.

As soon as these pioneers demonstrated their skill in control flying, many of us joined them. Since the start of this phase of modeling a few years back it has grown by leaps and bounds until today its enthusiasts have also outnumbered the free-flight builders.

Due to war-time restrictions, control-line flying has made great strides during 1943. The very fact that control-line ships are small, compact, and designed for speed has brought forth a number of designs which might not have been possible in larger ships. In fact, experimenters have practically gone mad in some of these designs, particularly those creations in the speed field.

Realizing that a greater portion of the flyability results from centrifugal action, some modelers have almost dispensed with wings—their finished designs resembling a bomb with a motor on it. Of course, landing is usually quite a messy business, but as long as a record is made or a prize is won, the wreck doesn't appear to make much difference.

Among unusual designs submitted during the year there were several that deserve mention. The Pusher Pursuit (published in the May, 1943, issue of Air Trails) featured an inverted motor, pusher prop, tricycle landing gear and extreme gull wing—yet flew well enough to place in several contests. Paul Plecan designed (for Air Trails) a twin-motor control job which flew well with two or even one motor. A West-coast builder emerged from his shop with a four-motor replica of a Flying Fortress and after some trouble in getting all motors to function properly, turned in fine performances. These ships, of course, were not specifically designed for speed alone. Other designs in this group were copies of full-size pursuit ships, and builders found that for once the scale-downs needed no great changes in outline such as would have been the case with free-flight designs. For the most part, tail areas remained in the same proportion in the control-line models and the ships flew well. This was due in part to the higher speeds attained in comparison with speeds of free-flight models.

All in all, the control-line field offers great possibilities in unusual design. Modelers can now design their dream ships and try them practically in their own back yard—with a minimum of danger so far as lost ships are concerned. Many ingenious modelers have contributed ideas which have been helpful to full-size aëronautics and also to the model field.

Perhaps the biggest factor in the success of control-line models is the feel that the builder gets in flying his job. By means of control lines he can actually pilot the plane in a series of maneuvers, some of them unintentional, of course. During 1943 a number of very ingenious uses were made of the control lines aside from those specified by the manufacturers. Jim Walker, pioneer of the control-line art, succeeded in developing a motor control which consisted in part of sending a high-voltage surge over the control wires. The surge actuated a relay, which in turn revved or retarded the engine. Similar uses of the wire were made which caused flaps to lower, motors to cut, parachutes to open, et cetera. One Canadian builder (inspired by what the Air Trails artist thought was a humorous drawing) flew his ship with the batteries on the ground, the current going to the ship over the control wires.

More recently, control-line ships without motors have been placed on the market. They maneuver like the powered models, but are less expensive, easier to build and open up a new market which is bound to boost the control-line game.

During the coming year it is expected that still further improvements will be made in the controlled-flight field. Planes still land "hot" and a dependable method must be designed to insure safe landings. Probably retractable landing gear that will extend at the end of a flight will be developed and certainly this will greatly improve speed planes—at least their durability.

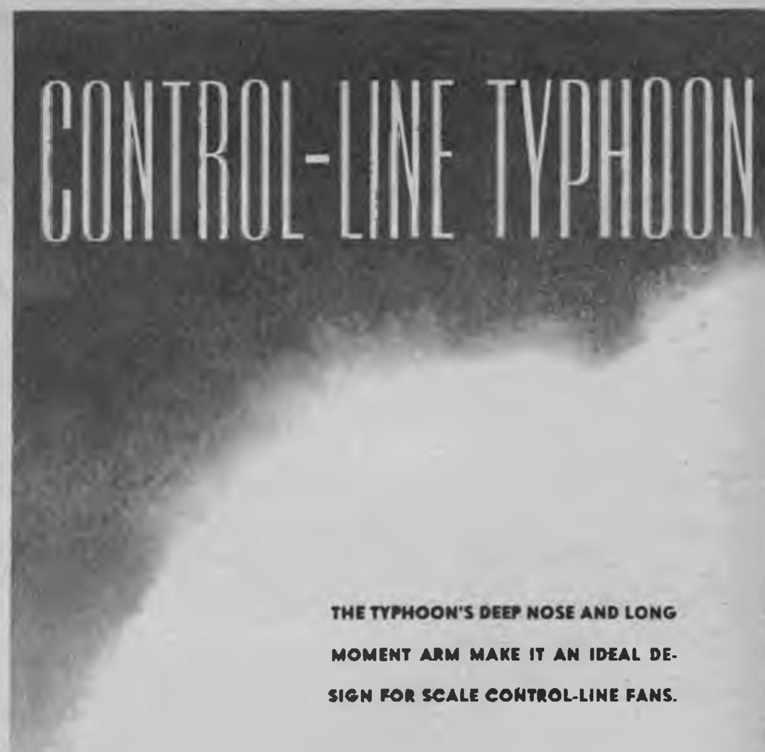
Speed ranks high as a reason for control-line popularity. When the first models were produced their speeds were rarely above fifty miles per hour. Then the "screwballs" started their dirty work. They began to install "hot" motors in the tiny ships, a feat which required some juggling of mounts but increased speeds considerably. Then came the clipping of wings, which also hopped up the speed, but the most important contribution was no doubt the development of the high-pitch prop. The prop was designed around an oversize hub, in keeping with findings that prop efficiency is highest at a point about thirty-three percent of the radius out from the hub. Reasoned the designers; If props are most efficient at this point, extend the hub, thereby cutting down center drag. The idea worked, and soon certain control-line groups were pushing speeds into the 100-mile-per-hour ring.

No official speed records have been established, but several "hot" ships have exceeded 100 miles per hour in special tests. However, inasmuch as no standards for length of control line or for specifications of ships in regard to areas, weights, et cetera, have been established, such records have not been recorded. To remedy this situation, the Academy of Model Aeronautics has recently drawn up a sample version of rules for the flying of control-line craft. It is expected that the Rules Committee will approve and release these rules to the modelers in the very near future.

All in all, modelers who have turned to control-line flying have certainly added many new "kinks" to their model education. Usually newcomers to the control-line art redesign a standard free-flight model for their first such craft. These models, known as "goats," set few speed records, but they are slow-flying and from them a modeler may easily learn control characteristics. Because of their slower flights, they are generally much more enduring in inexperienced hands.

Recent reports indicate that control-line ships are being seriously considered for target work in gunnery-training schools. As we see the stubby-winged little ships whizzing around with amazing speed we can easily see how ability to hit one of them in midair with a machine gun would make our gunners even more superior to any in the world. In the days and months to come, control-line flying will continue to grow. New ships, new designs, new control devices will certainly be forthcoming. Even a war cannot keep American youth from keen interest not only in aeronautics, but in building and flying models.

CONTROL-LINE TYPHOON



THE TYPHOON'S DEEP NOSE AND LONG MOMENT ARM MAKE IT AN IDEAL DESIGN FOR SCALE CONTROL-LINE FANS.

WE wish more aircraft designers would be as considerate of the model builders as were the engineers at Hawker. The large air scoop beneath the spinner not only allows the engine to be entirely inclosed in the model, but also provides perfect cooling. The air exists just under the leading edge of the wing and the whole engine installation is conducive to keeping the engine cool—a feature usually sacrificed on scale jobs, the result being excessive piston and cylinder wear. Another feature of the Typhoon design that is excellent for guide-line flying is the long fuselage aft of the wing—the wing on the real plane having been moved forward to balance the ship with the weight of the twenty-four-cylinder motor hanging in the nose. This long moment arm will mean better control of the model than is had with scale models of the average pursuit ship.

As for details—the scale bug can really go to work on this crate. The paint job is interesting—the original ships had to have black-and-white stripes painted on the bottom of the center portion of the wing so that Allied ground gunners wouldn't fire on it. These stripes, the insignia, and the large white letters make one wonder why the English bother to camouflage their planes with sky-blue underneath and dark, greenish brown on top. There are more details that can be put into the Typhoon: for instance, landing lights that work as well as wing-tip lights, and last, but definitely not least, the four cannon. The cannon were mentioned last, and that is when they should be put on—after the paint job is finished. The builders had quite a bit of difficulty with the original job—dodging cannon while adding the final paint details.

Starting at the beginning, the fuselage crutch and formers need no detailed instruction. The entire fuselage is planked with $^3/_{32}$" x ¼" balsa or $^1/_{16}$" pine. The planking should be carried right over the firewall above the crutch and the upper nose block made a permanent part of the fuselage, since the engine is mounted beneath the bearers. The lower cowl can be carved from a block of balsa or pine, or it can be molded, using the usual form and strips of newspaper with either celluloid cement or the new plastic glues as an adhesive. Battery box, coil, and the mount for the control plate should go in before the planking is completed. For finishing, a good coat or two of wood filler sanded with #400 wet or dry paper will give that famous "mirror finish." Some may find it easier to paint the entire model after assembly, but the original model was painted piece by piece and then assembled.

The entire set of tail surfaces is cut from ⅛" sheet pine or balsa and shaped as shown. The simplest method of tail assembly is to mount the stabilizer first, cutting out the fuselage planking for it, and then gluing it securely. The elevators come next, with the wire-control rod. Glue the outer hinge pins in place on the elevators, and

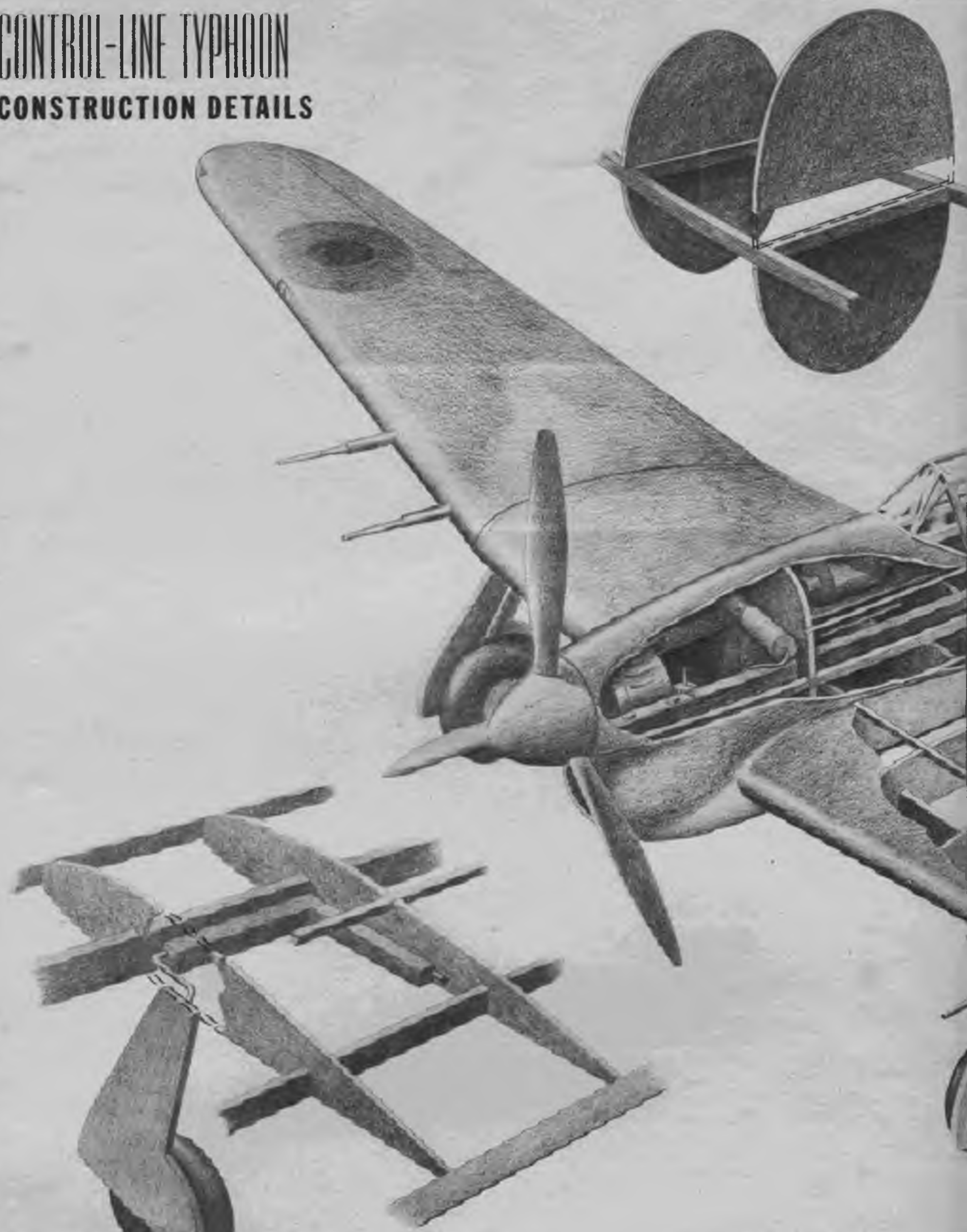
By Robert Salisbury

the bushings in place in the ends of the stabilizer as well as the side of the fuselage. Slide the outer hinges in place and glue the inner end of each elevator to the control rod. Before mounting the fin and rudder, insert the push rod that runs up forward to the control plate. Make sure everything works properly before gluing the fin in place and closing the fuselage. Messy business, cutting a hand-hole in a planked fuselage.

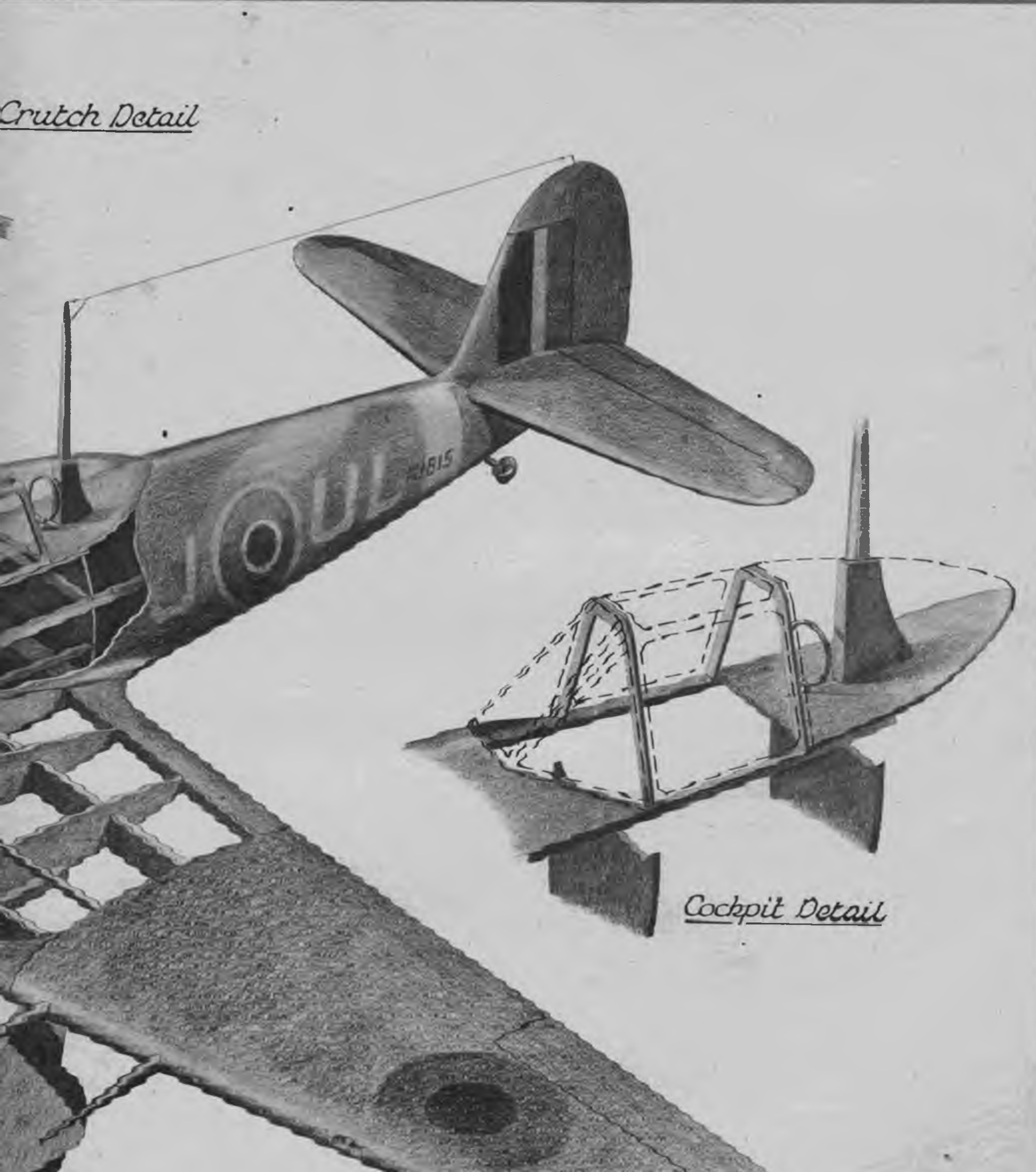
The wing is easy to build, if the spars and ribs are carefully cut to the drawing. There's always a catch to that "easy" statement. Seriously; if the spars are bent to the proper angles and the plywood gussets glued in place before assembly, all that is needed is to pin the spars over the drawing and put the ribs in place. The dihedral is automatically taken care of by the spars; and the leading edge, trailing edge, and tips can be put on while the builder is reclining in his favorite easy-chair (if no one objects to spilled cement and dope). Leading-edge covering on top back to the $1/_{10}$" x ¼" spar is $1/_{16}$" sheet, either balsa or pine. Cover the root ribs and between the two spars with sheet balsa or pine, too.

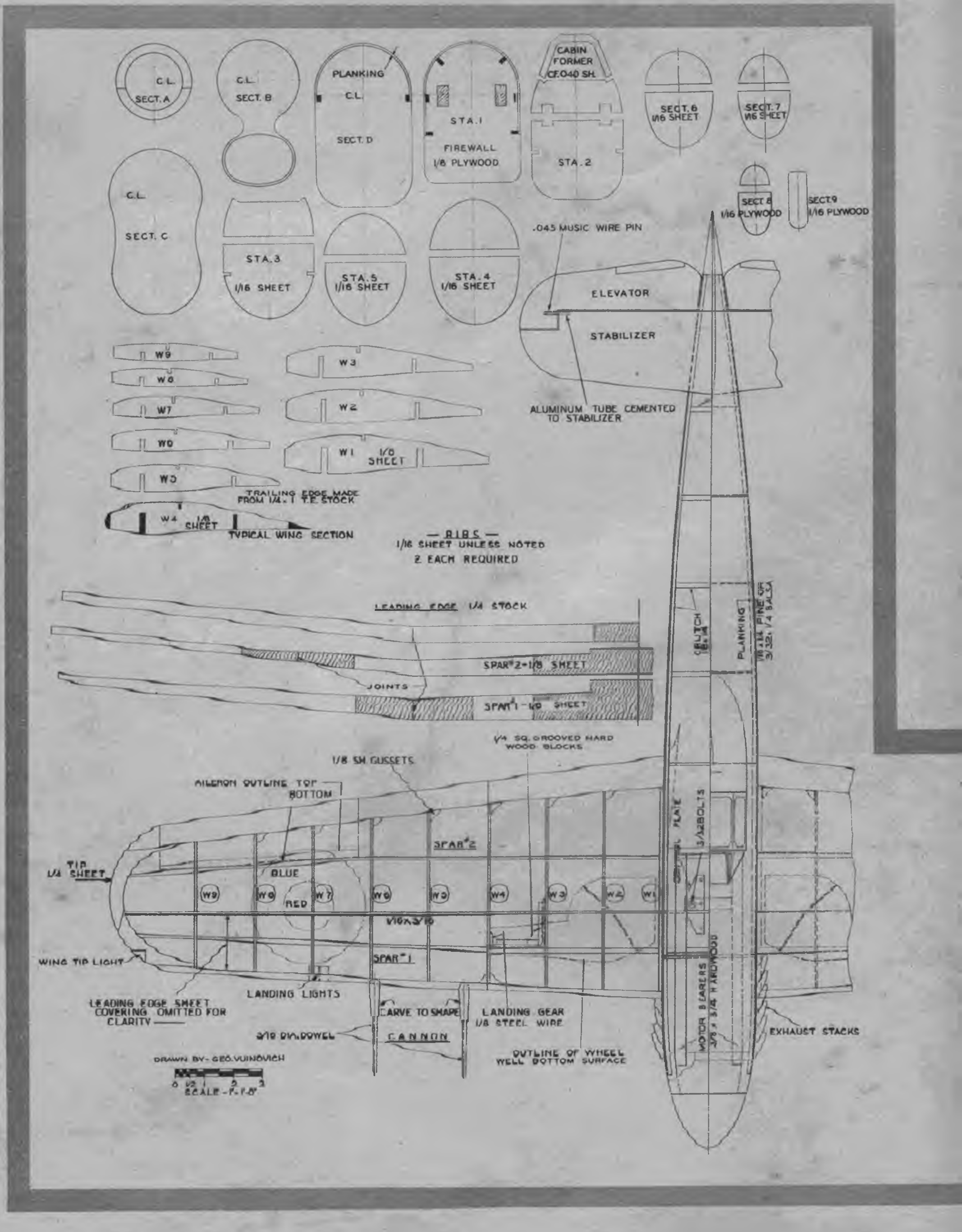
If you don't know how to fly a guide-liner or a U-control, get your hands on someone that does—and don't let go until he's taught you how to do it. Sounds like being a sissy, but it's better than cracking up on the first flight—ask the boy who's done it.

CONTROL-LINE TYPHOON
CONSTRUCTION DETAILS



Landing Gear Detail


Crutch Detail
Cockpit Detail


C.L.
SECT. A
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PLANKING
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STA. 1
FIREWALL
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SECT. 7
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.045 MUSIC WIRE PIN
ELEVATOR
STABILIZER
ALUMINUM TUBE CEMENTED TO STABILIZER
W9
W8
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W3
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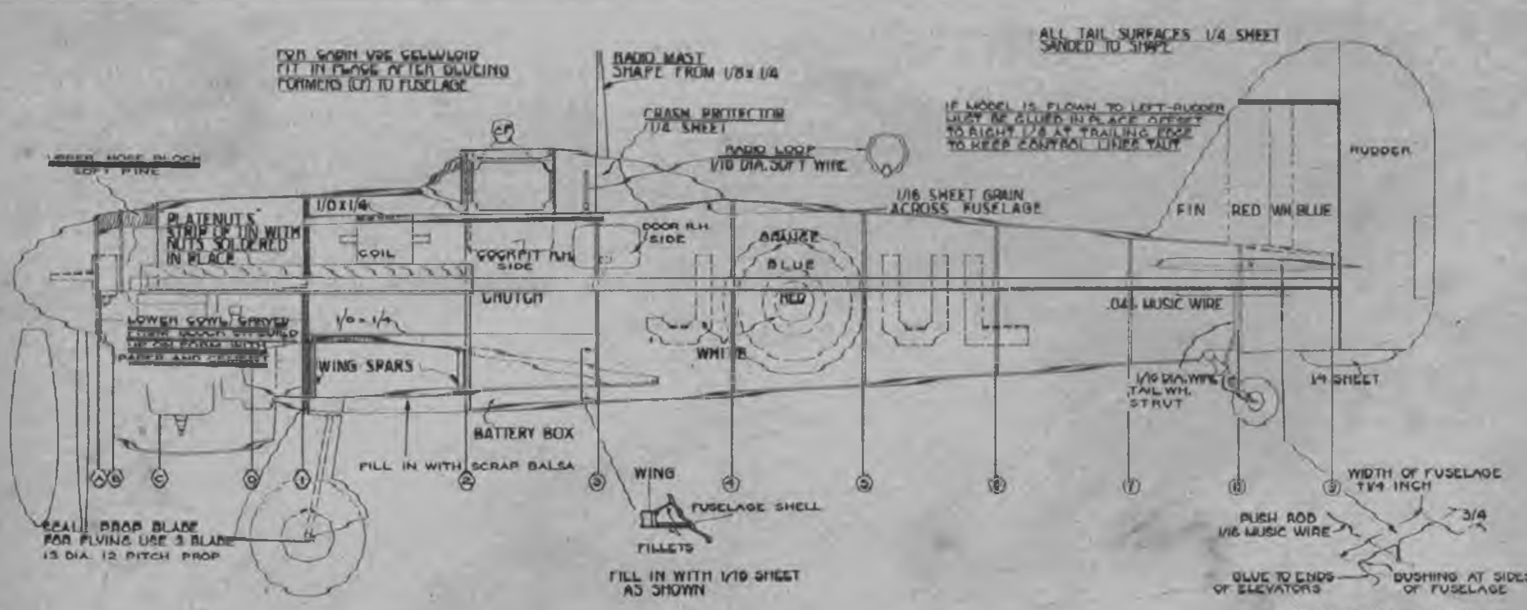
W1 1/8 SHEET
W4 1/8 SHEET
TRAILING EDGE MADE FROM 1/4 x 1 T.E. STOCK
TYPICAL WING SECTION
— RIBS —
1/16 SHEET UNLESS NOTED
2 EACH REQUIRED
LEADING EDGE 1/4 STOCK
SPAR #2 - 1/8 SHEET
JOINTS
SPAR #1 - 1/8 SHEET
PLANKING
1/16 x 1/4 PINE OR 3/32 x 1/4 BALSA
1/4 SQ. GROOVED HARD WOOD BLOCKS
1/8 SH. GUSSETS
AILERON OUTLINE TOP
BOTTOM
SPAR #2
TIP 1/4 SHEET
BLUE
RED
1/16 x 3/16
SPAR #1
3/32 BOLTS
WING TIP LIGHT
LANDING LIGHTS
LEADING EDGE SHEET COVERING OMITTED FOR CLARITY
CARVE TO SHAPE
LANDING GEAR
1/8 STEEL WIRE
3/16 DIA. DOWEL
CANNON
OUTLINE OF WHEEL WELL BOTTOM SURFACE
MOTOR BEARERS
3/8 x 3/4 HARDWOOD
EXHAUST STACKS
DRAWN BY - GEO. VUINOVICH
SCALE - 1" = 1.8"

This close-up of the nose clearly shows the engine mounting detail. The cowl can be made by the plastic method.

This three-quarter view gives the finished model a very realistic appearance. The wide-tread landing gear assures good landing controllability.



FLY FOR FUN

GLIDER PICKUP

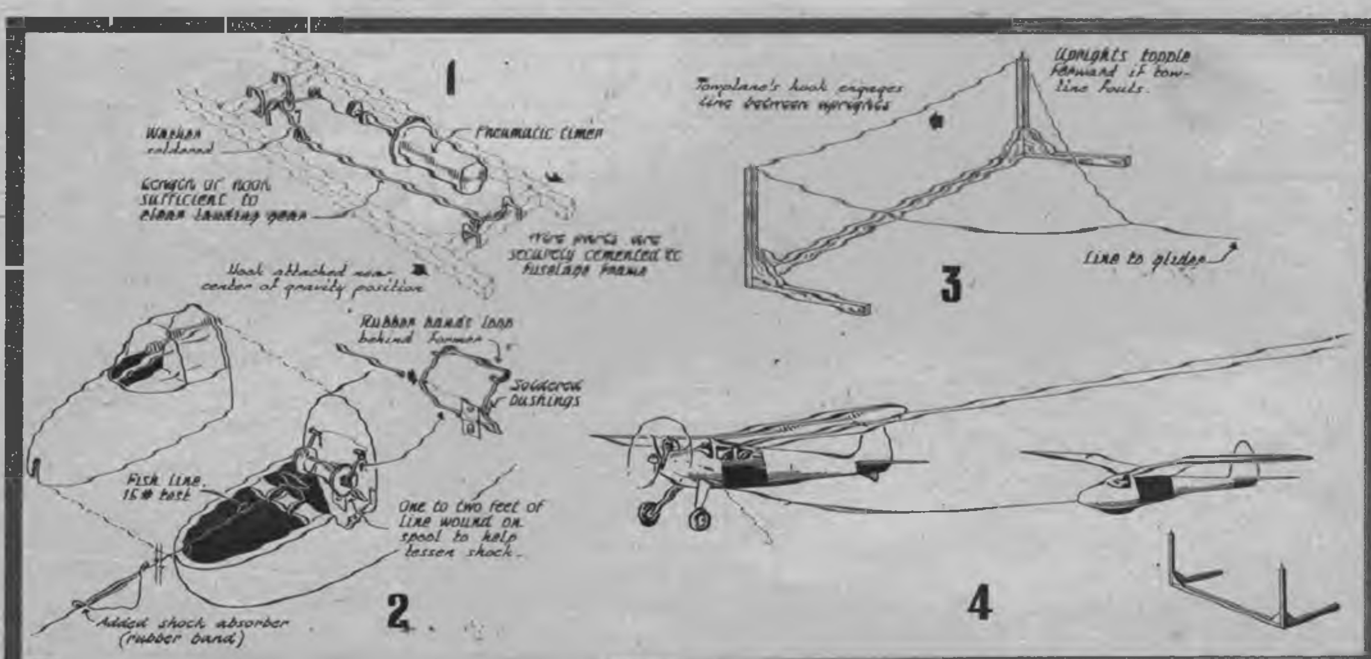
By Bill Mc Candless

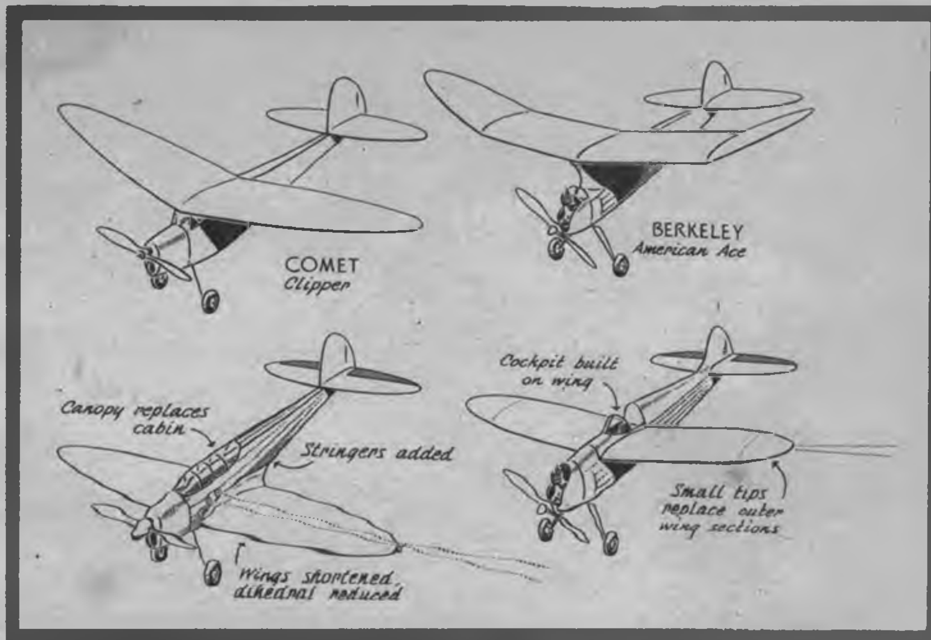
PUT ASIDE YOUR CLIPPED-WING SPEEDSTERS AND TRY THESE NOVEL IDEAS FOR MORE FUN FROM CONTROL-LINE FLYING.

IN much the same manner that army transport planes pick up gliders in full flight, a slow-flying U-control model can pick up a good-sized glider—another realistic development in control-line flying.

The control-line model should not be a high-speed type or initial shock would be too great. A converted free-flight model or "goat" would probably serve best. The glider should be able to withstand the sudden pickup. Its rudder tab should be slightly offset toward the outside of the circle and it should balance for level flight at the speed of the towplane.

Sketch #1 shows the pickup hook and its release. Fasten parts securely and see that the hook hangs below the landing gear. In the nose of the glider, Sketch #2, there is a spool reel which plays out a foot or two of line at the instant of pickup to lessen the shock. It is mounted flexibly, and an extra shock absorber is fixed into the towline. Sketch #3 shows the simple stand which holds the line in position for pickup. The complete arrangement is shown in Sketch #4. The length of the towline varies with the size of the control model and glider, and also with the length of control lines,





TRY A GOAT

By Don Fuqua

DO you have an old free-flight gassie lying around your shop, buddy? Well, here's an idea for using that discarded crate: try a "goat." If you are a novice U-controller, you will know that a "goat" is a ship formerly used as a free-flight job and converted to U-control.

There are thousands of discarded gassies lying around that can very easily be converted. These models have been retired from active flying for any one of a thousand reasons: some have become obsolete in design, some have had a year or so of contest flying, and some have suffered a minor crack-up and simply been set aside. Not only have the planes themselves been set aside, but in hundreds of instances the engines have been discarded along with them. In most cases these engines are still "perkable," although they never did have the zip of the newer ones. Since these engines are no longer being manufactured, they have become valuable assets and will have to be called into service if modeling is to continue as one of the nation's best hobbies.

But getting back to the subject, there was an old Herkimer-powered Clipper in the workshop, which, after investigation, proved to be fairly sound and in pretty good shape. It had been pretty hot stuff in its day, but its day was past. After uncovering, the wing was cut down from six feet to fifty-two inches, then mounted as a low wing; the fuselage was streamlined, and control added. After recovering the ship and doping it, it not only looked plenty zippy, but the performance was something to write home about. It was neither too fast nor too slow, but the control was absolute and positive, something which wasn't found in the kit job.

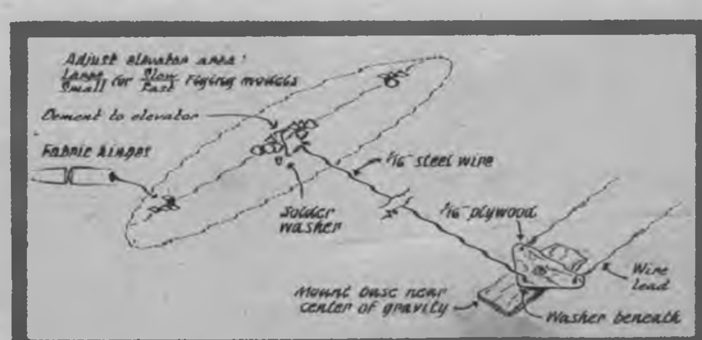
Since that time, there have been fourteen "goats," or conversions, made in this club alone. Everything from a Zipper to an old-time KG has been converted, and the results have been amazing.

The method of conversion approved by the local club is simple. In the case of an extremely high wing mount, or pylon type of design, the wing should be mounted either as a low wing or midwing. A midwing mount is best if the wing area is not cut down, since speed compensates slightly for stability. It is not necessary to decrease the extended wing area, but if additional speed is desired it is advisable to do so. There can be no set formula for this operation, since it depends largely on the size and condition of the engine to be used, and the size and general design of the original plane. If the wing area is not altered, the angle of incidence should be decreased to approximately half and the tail surfaces should be set at zero degrees incidence. If the wing panel is decreased appreciably, about two thirds the original incidence should be used, although, as originally stated, this depends largely upon the engine and original model to be converted.

Control surfaces are easily built into the average "goat." The elevator is simply uncovered, the desired control area marked off, and the area separated from the stabilizer with a sharp knife or razor blade. The trailing edge of the stabilizer, and the leading edge of the elevator thus exposed, is then built up with one-eighth-inch sheet balsa or basswood, and cloth hinges installed in the following manner. Cloth strips, about a quarter of an inch wide and long enough to fit properly, are cut from silk, linen, or heavy muslin. They should be spaced on either side of each rib. The first hinge piece should be cemented to the upper side of the elevator and the lower side of the stabilizer. The second strip should be cemented to the upper side of the stabilizer and the lower side of the elevator and each succeeding strip alternated in this manner until the control surface is firmly attached and works freely.

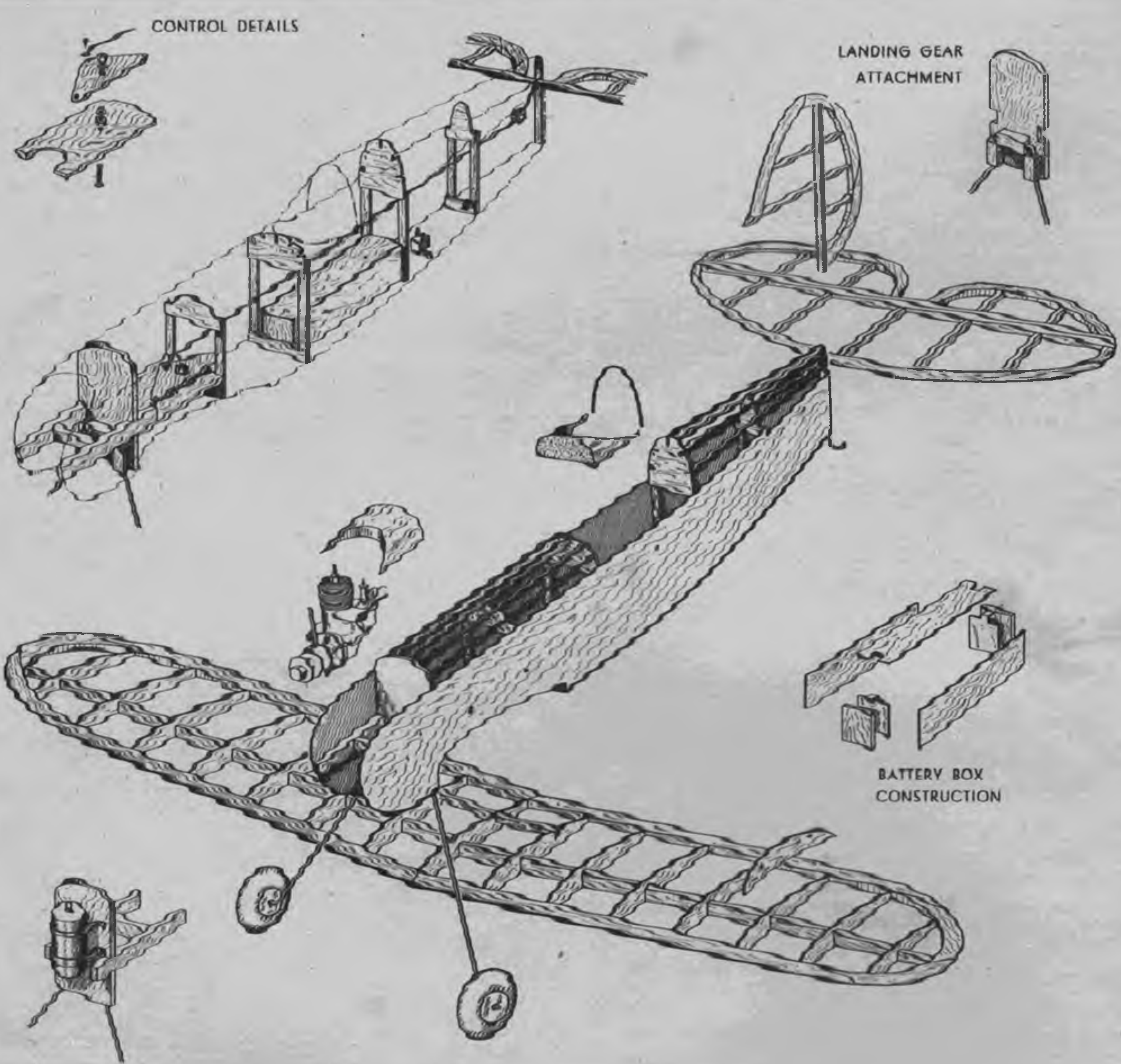
Streamlining the fuselage with formers and stringers will not only enhance the general beauty of the ship, but also improve the performance. This is particularly true of the older, box-type fuselage jobs.

Although the average "goat" sounds very slow indeed, this is not necessarily true, for a converted KGS recently made a record of 56.76 m. p. h. without even any decrease in the wing area.



TETHERED TRAINER By Earl Cayton

YOU WOULDN'T LEARN TO FLY IN A THUNDERBOLT, SO WHY START CONTROL-LINING WITH A SPEED JOB? THIS MODEL IS DESIGNED SPECIFICALLY FOR THE BEGINNER, BUT BY USING A LARGER ENGINE SHE'LL HIT 70 M. P. H.



THERE has long been a definite need for a beginner's control-line model. Too often have enthusiastic beginners entered this new phase of model building with complicated 100-mile-per-hour-plus clipped-wing super jobs, only to be discouraged when models were reduced to scrap after the first few flights.

With this in mind, the Tethered Trainer was designed expressly to fit the needs of those builders who are just entering the "controlled" field. Not even the greenest beginner will find difficulty in handling this tethered trainer, as efficient proportions and size make stability inherent. A happy combination of good looks and simplicity enable any beginner to be considered on the same par as more advanced guideliners.

Powered by motors of .19-.23 cubic inch displacement, the Tethered Trainer zips around the course fast enough to perform any stunt but a snap roll. When the motor cuts, this model assumes a normal glide, thus saving on both props and nerves. This construction would be strong even with balsa, but with hardwood the trainer is practically crashproof!

Are you the type that wants to advance until you are capable of handling "hot" jobs for tethered speed meets, or do you just want to fly a highly maneuverable job that is stable enough to fly safely and yet which will perform at speeds that are "sporty"? We've anticipated either category. The mounts are flexible enough to fit most large-bore motors. (Mounts may be made to fit individual crankcases merely by widening the top view.) By just substituting a Bunch Tiger or motor of similar displacement, speeds of from sixty to seventy miles per hour may be obtained with the other characteristics of the lower-powered version still retained. If you want "superspeed" for speed contests, you may graduate until you own one of the "hottest" little spin-dizzies that ever entered a contest merely by clipping half of the area off the wings, substituting a retractable landing gear and adding a Hornet or Super Cyclone to do the work up front. No matter what you expect in a U-control job, you will want to build the Tethered Trainer.

CONSTRUCTION

The construction is so simple that the photos and plans practically speak for themselves. However, you may want a few pointers in the use of hardwoods. Practically any hardwood will do, but for the sake of nicked and blistered fingers, to say nothing of sore tempers, we would suggest selecting a variety of wood that is easily carved. We have found that white pine, sugar pine, bass wood, cedar and spruce are excellent for this purpose. If you are one of these balsa hoarders, you may use balsa, but you should enlarge wood sizes proportionately.

For most cutting purposes razor blades are out of the question. A good sharp fish knife or pocket knife will do. A little coping saw will be handy for cutting out tail and tip outlines, et cetera, and a small plane will prove invaluable for cutting down leading and trailing edges, tip outlines, et cetera. Casco and other glues hold better on hardwoods, but take quite a while to dry. Regular model cement will do if a little fillet is made around the joint.

FLYING

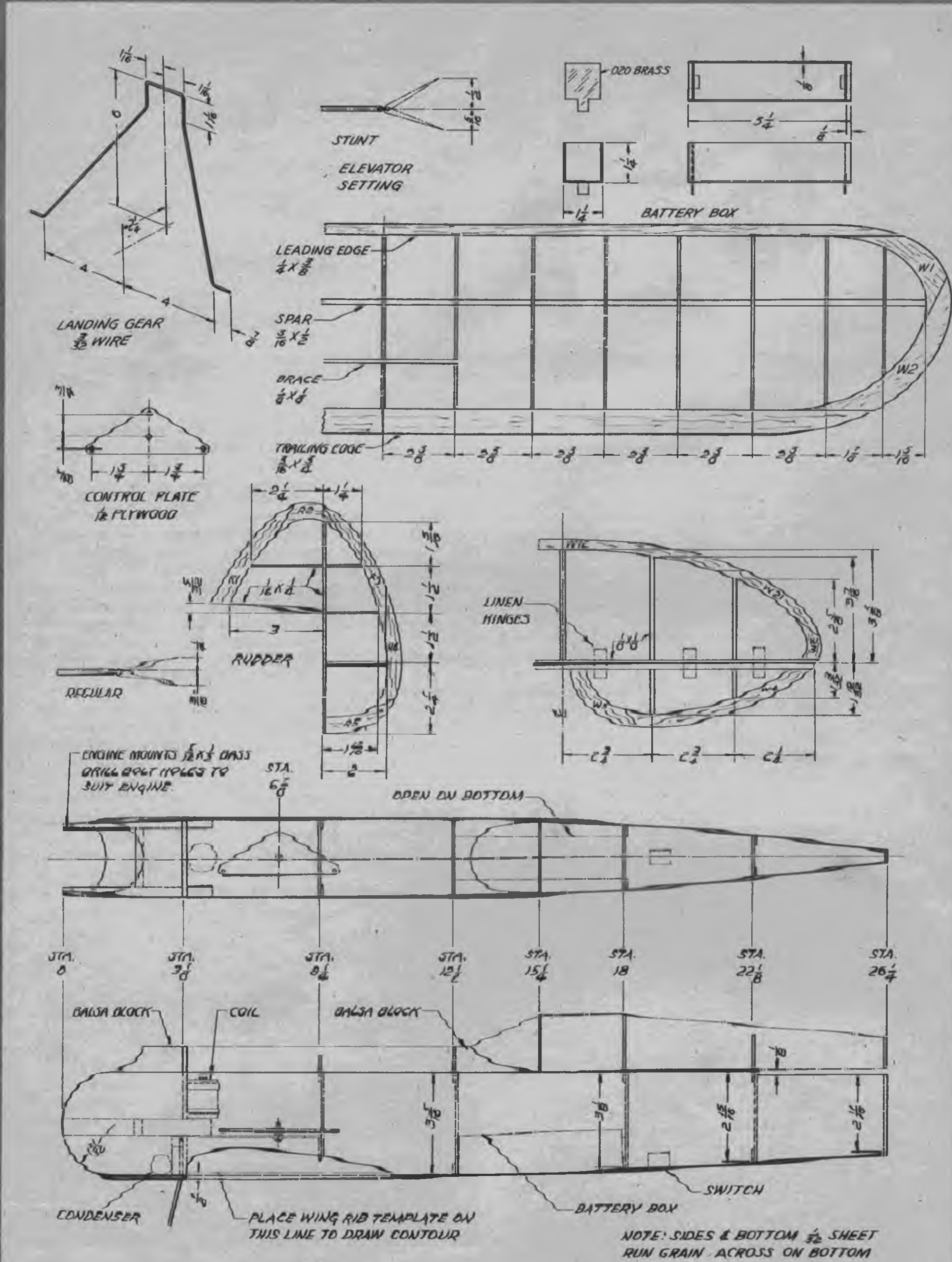
Now that we are through with the construction of the model, we are ready to take it out to the nearest lot to fly. But wait! In just a shake we can attach a motor switch that will prove invaluable for cutting the motor at precise moments. Simply attach a third line to either your toggle switch or high-tension lead.

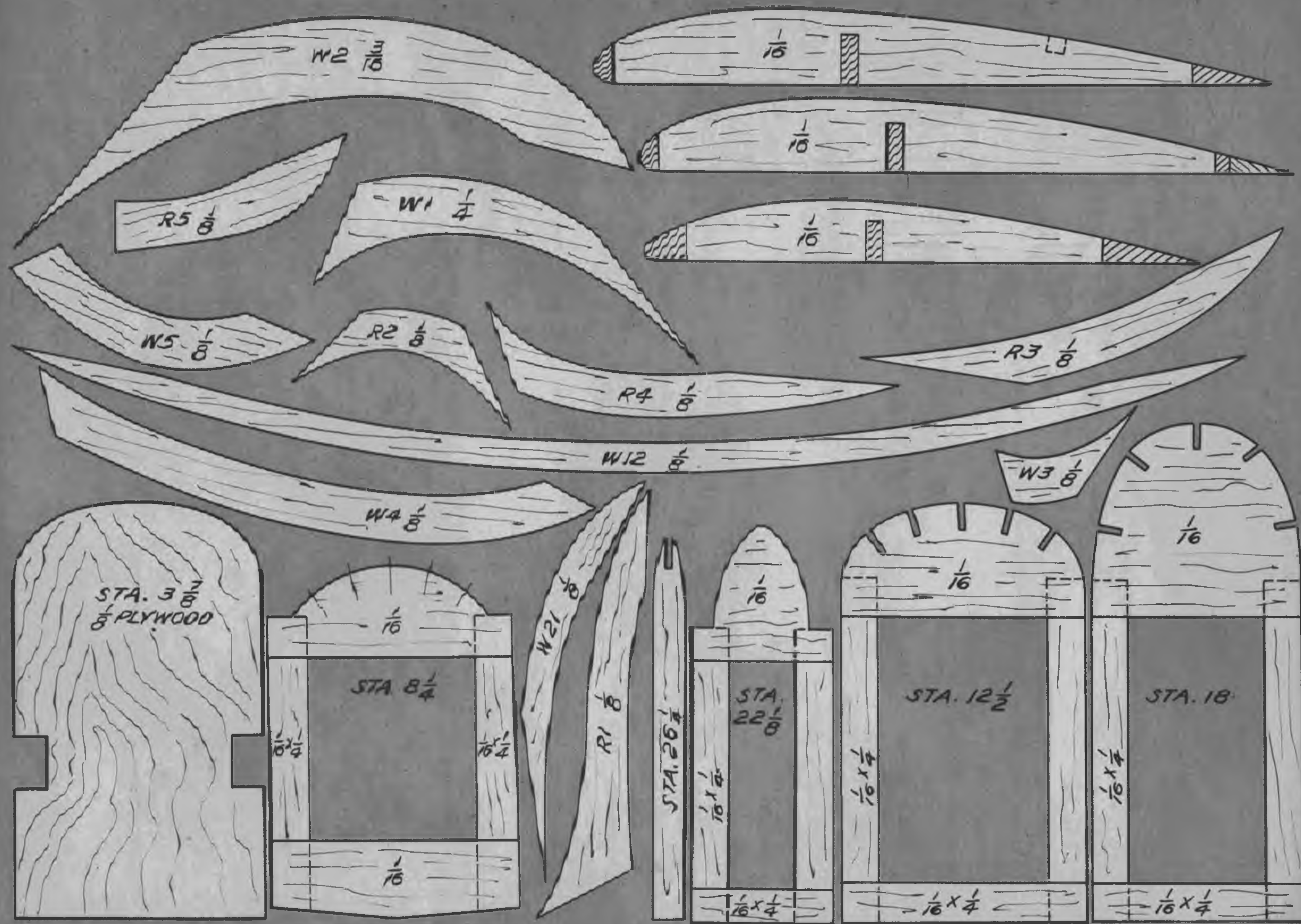
If this is the first time that you have flown a control job, it might be well to select a calm day. First of all, even before you get your motor running, look out for spectators. Long experience gained the hard way by not only myself but practically every guide-liner that I have ever met, teaches that this is the time to threaten every little squirt and empound every pooch that so much as looks as if he will get entangled in the lines.

Now you may start your motor and open it to about half throttle, assuming that you are using a .19-.23 cubic inch displacement motor. Now, have your partner let the model take off by setting it on the ground and pointing the model slightly to the outside of the circle. This will keep out any slack that might form on the take-off. The model should take off and climb slowly into the air. Increase power as your ability increases, until you can get the ship to do anything that a real one can do except a roll. Happy landings.

(The control-line mechanism shown on these plans is intended for the use of individual model builders. Patent regulations prohibit manufacture of kits.)

This model is stable yet maneuverable. If the motor cuts she glides slowly to earth in one piece, due to large wing area. Designer Cayton is on the lines.


LANDING GEAR
3/32 WIRE
STUNT
ELEVATOR
SETTING
.020 BRASS
BATTERY BOX
LEADING EDGE 1/4 X 3/8
SPAR 3/16 X 1/2
BRACE 1/8 X 1/8
TRAILING EDGE 3/16 X 3/4
CONTROL PLATE
1/16 PLYWOOD
RUDDER
REGULAR
LINEN HINGES
ENGINE MOUNTS 5/16 X 5/8 BASS
DRILL BOLT HOLES TO
SUIT ENGINE
OPEN ON BOTTOM
STA. 0
STA. 3 7/8
STA. 6 7/8
STA. 8 1/4
STA. 12 1/2
STA. 15 1/4
STA. 18
STA. 22 1/8
STA. 26 1/4
BALSA BLOCK
COIL
BALSA BLOCK
CONDENSER
PLACE WING RIB TEMPLATE ON
THIS LINE TO DRAW CONTOUR
BATTERY BOX
SWITCH
NOTE: SIDES & BOTTOM 1/32 SHEET
RUN GRAIN ACROSS ON BOTTOM



W2 3/16
1/16
1/16
1/16
R5 1/8
W1 1/4
W5 1/8
R2 1/8
R4 1/8
R3 1/8
W12 1/8
W3 1/8
W4 1/8
STA. 3 7/8
1/8 PLYWOOD
1/16
STA. 8 1/4
1/16 x 1/4
1/16 x 1/4
1/16
W21 1/8
R1 1/8
STA. 26 1/4
1/16
STA. 22 1/8
1/16 x 1/4
1/16 x 1/4
1/16
STA. 12 1/2
1/16 x 1/4
1/16 x 1/4
1/16
STA. 18
1/16 x 1/4
1/16 x 1/4

CLOSED COURSE CLOSE-UPS

WEST COAST "NATIONAL TETHERLINE CHAMPIONSHIPS" RESULTS SHOWED UNOFFICIAL SPEEDS OF OVER 100 M. P. H. BY "SOUPED-UP" FLYING ENGINES.

This ship, built by Wayne Leasure, took first place in team exhibition. Wayne is an expert at mimic combats; three ships fighting at once.

Howard Broughton took third place in the Class B event with this streamlined bullet. Note special prop for high speed rather than for climb.

Keith Goodwin's record holder did 92.07 m. p. h. after a bad crash. Before the meet it turned in an unofficial clocking of 115 m. p. h.

A 60 m. p. h. job, by Frank Greene, features retractable gear. An extra line pulls a catch pin, releasing take-off dolly. Timer later releases wheels.

Despite the weird design, this "flying ray", clocked 92.5 m. p. h. for owner Tony Naccarado. Latter won first in Class A event. Stable flier.

Granger Williams designed his model around the famous Davis airfoil with outstanding success. Model features inverted motor; tricycle landing gear.

THE amazing growth of control-line flying has the country literally going around in circles. Initially introduced on the West coast by Jim Walker, and in Texas by Vic Stanzel, this new phase of our hobby has mushroomed to its present size, where it threatens to displace free-flight gas models in popularity. Recent coast contests have already introduced many new technical developments such as specially designed propellers, retractable landing gears, and "souped up" engines. Speed flying, however, is not the only feature of this sport. Stunt flying attracts many contestants, and mimic dogfights have been reported with three ships zooming around in the air at once, the boys raising the lines above each other's heads as each ship passes overhead. Converted free-flight gassies called "goats" are used by beginners as a simple way to learn the knack of handling the ropes.

The need for suitable rules standardizing events is becoming increasingly apparent, and all model builders should write to the Academy of Model Aeronautics to have their opinions brought to the attention of a committee now working on this problem. (Drawings from photos by Robert Lloyd Brown)

This snappy Class A job, by Danny Greene, is not only exceptionally fast, but shows that control-line models can have realism with high speeds.

This ship not only had a beautiful appearance, but its performance was equally impressive. Note rudder is placed ahead of stab for stability.

Second place, Class C winner with 80 m. p. h. Landing gear has extra-wide tread to prevent ground loops. Also has new high-speed propeller.

A converted "Cavalier," "goat" to you, works swell, despite its size. Owner, E. D. Hopkins, an engine expert, co-engineered many winners.

Really, it actually flies, but test hops showed that this type of flying wing needed a more stable airfoil to improve its longitudinal stability.

Here's one for the books! This "Flying Milk Bottle," the old Gee Bee, not only took second in Beauty Event, but had speed of over 60 m. p. h.

STIRLING ON A STRING

By Ellis Sigmon

THE SKY'S THE LIMIT WITH CONTROL-LINING. YOU CAN EVEN FLY A SIX-FOOT STIRLING IF YOU'RE AGILE ENOUGH TO GET ALL FOUR ENGINES GOING BEFORE THE FIRST ONE RUNS OUT OF GAS.

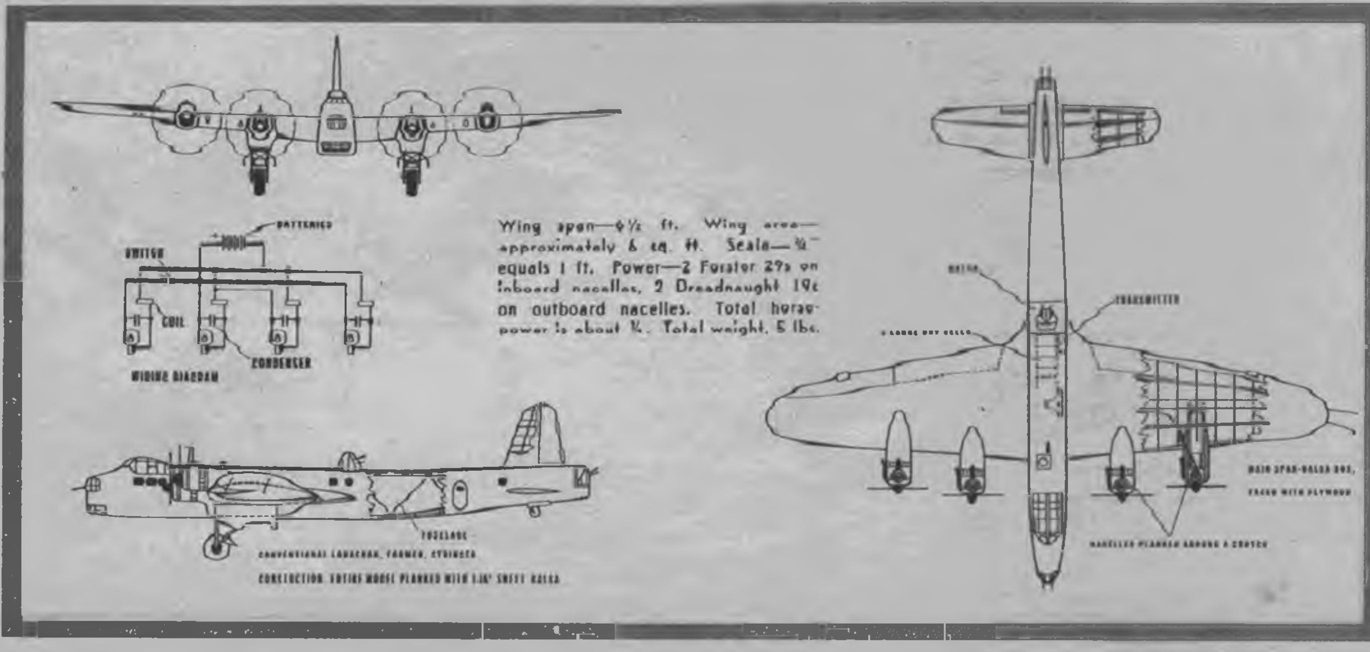
WITH the help of a fellow control-liner, I set to work on my three-quarter-inch-to-the-foot Stirling. This scale gave a six-and-one-half-foot span.

The job is somewhat heavy, although it is all balsa. It was expected that it would get quite a beating, so besides completely sheeting the job with 1/16" balsa, the wing spars were built up from 1/8" stock in the box design and then sheeted with plywood. The whole job is one piece for strength.

Power is two Forster 29s in the inner nacelles and two Dreadnaught 19s. This adds up to three quarters of a horsepower. The job will fly on either of the matched pair of engines. Large capacity gas tanks are used, one in each nacelle, for endurance and to give enough fuel to start all four engines before one runs out of gas. There are fifteen feet of wire in the circuit; a coil in each nacelle. Boosters are not used; enough voltage is supplied by four large flashlight batteries wired in parallel. A third control line connects to a knife switch on the side of the fuselage so that the two outboard engines can be cut in flight, thus eliminating dangerous turning moments if one, two, or three engines fail. Weight is five pounds, with an eighteen-ounce loading. With a ten-pound pull on the line, one gets that all-the-eggs-in-one-basket feeling.

The crew is there in miniature, Mae Wests and all!

Here she is, scaled even to dummy pilot, co-pilot, Mae West and all. You'll get an idea of its size from the middle photo. Top—it proves that it flies.



Wing span—6½ ft. Wing area—approximately 6 sq. ft. Scale—¾" equals 1 ft. Power—2 Forster 29s on inboard nacelles, 2 Dreadnaught 19s on outboard nacelles. Total horsepower is about ¾. Total weight, 5 lbs.

Design

THE problem of what new model to design is really a tough one for the boys these days. Contest gas-model design has been stymied into two types—last year's models without landing gears, and the flying broomstick type—by the controversy over the A. M. A. contest rules. No one seems to know just yet what is going to happen to the rules, and the boys aren't wasting any of that precious supply of balsa on ships that may not meet the specifications for 1944 contests.

On the other hand the war seems to have stimulated the activities of the "theory boys." Experiments with such things as flying wings, canards, and the like are increasing. Such types of experimental models are becoming more and more commonplace on the flying field and should eventually lead to some more trouble with rules—where does a flying wing or canard fit into the picture as we have it now? There is no experimental class nor any classes set aside for particular models of the generally termed "experimental type."

While nothing new or startling has been introduced in the way of free-flight models for the past year or so, letters from boys in service seem to indicate that a lot of the model builders now out in the far reaches of the world are doing a lot of thinking about those models they intend to build when they return to normal life. Sketches have been sent along where possible and some of the ideas are certainly startling. One thing that the situation of having time to think of designs and not being able to build them has done is to offer these boys the opportunity to really think out the reason for such things as the wing and stab location, areas, where the C. L. A. belongs, et cetera. We can look for more carefully designed ships after the war—with less of the "Let's build a new ship. We can start tonight and have it flying the day after tomorrow."

While design itself hasn't presented much in the way of new developments, the startling hold that guide-line models have taken on the model hobby certainly opens up a new field for a fellow's ingenuity. Speed events alone are going to foster much research into drag and its causes, once the competition rules are set up. Whether to streamline those landing-gear struts or retract the legs will be one question. Wing loadings may go up so sky-high as to require the use of operating flaps for landing and possibly take-off if the model is to be flown more than once. In aerodynamic design, the use of thinner airfoils with a lower drag coefficient will become a necessity, and it may even lead to the use of the new laminar-flow airfoils. Body shape and design in general will not consist of merely having something to hang a wing and tail together with—and the engine out in the breeze. The brute force of the Hornet engine will not last long when the "brain busters" start figuring out how to keep drag to a minimum.

Flying scale models, both of the rubber free-flight and gas guide-line variety, seem to be increasing, although the methods of design here are somewhat limited. Guide-line models offer the least opportunity for the modeler to use his noggin in the aerodynamics field, but the most in the construction-design end. Free-flight flying scale models always present a challenge to even the foremost modelers. Despite the difficulty of replacing the control of a human pilot with inherent stability in a flying scale model, we have noticed that a much larger percentage of the ships of this type seen on the fields recently have really flown well.

To get down to actual cases of aerodynamic design, in the past year we have seen such happen as the complete explanation of tip plates in language that the average modeler could understand. An explanation of why they were used is typical of what the model hobby needs more of. Induced drag, profile drag, and even lift over drag ratio (L/D) are entirely too much of a mystery to most modelers. While we do not advocate a complete course in model aerodynamics prior to building your first model airplane, a study of why things happen and how certain points of a design react on the flight of a model certainly make the sport more interesting.

One interesting item that the wartime contest rules introduced was dethermalizers—a complete study of the subject by H. A. Thomas in the March, 1943, issue of Air Trails brought to light an interesting thought. Despite the fact that dethermalizers seek to destroy the aerodynamic advantages built into a model in order to keep it from putting in more than the prescribed time, the model builders certainly went to work with a vengeance and turned up all sorts of workable ideas. Everything from spools of thread that dropped out of wing tips to extra fins that popped up into a vertical position when required were tested and retested. This proves that given the opportunity, model-building brains will continue to keep the basic design requirement of over-all efficiency uppermost in their minds—despite the fact that they must destroy this efficiency four minutes after the model leaves their hands.

FLYING WINGS

THE absence of fuselage and tail surfaces makes the flying wing aerodynamically and structurally superior to conventional types of aircraft. Nevertheless, despite these advantages, there have been few successful tailless designs—and yet birds prove that high performance is attainable.

The most well-known among man-made tailless airplanes are Waterman's Arrowbile and, more recently, the Northrop Flying Wing. The development of these planes and the remarkable flights of the birds indicate that further experiment will pay great dividends.

Presented in this article are three basic designs which were developed through glider experiments and bird observation. The many problems which come up in building a tailless model will be discussed so that the reader will have an insight into tailless design and avoid many of the pitfalls of experimentation.

Design No. 1 was selected from a number of balsa test gliders because it showed the greatest stability and could be made to circle very tightly without spiraling in. This enables the model to stay in the slightest updraft and ride the wind like the birds, a great advantage over normal craft. After thorough glider tests, the design was scaled up to Class A size and powered with an Elf single. The symmetrical Davis section and slotted wing tips were the key points of the design.

Test flights verified the stability of the design, but two defects were brought out: (1) the streamlined airfoil induced excessive speeds; (2) the tractor arrangement increased the prop shortage. The model as it stands would make an excellent speed job, but for endurance purposes it is out of the question. The model could be slowed down by building it larger and decreasing the wing loading, or by using a high-lift wing with washout.

Design No. 2 shows the changes which were made to produce a slower model. The use of a high-lift section insured a high positive pressure, but also induced a diving moment. Rather than turn up the ailerons to excessive angles for control, the diving moment was compensated for by varying the airfoil section and by incorporating a slight washout. Note that the forward section is the very-high-lift Davis No. 5 which gradually changes to a Clark Y near the tips. This produces a moment which counteracts the airfoil diving tendencies. (The principle is analogous to the lifting stabilizer.) With this arrangement the center of gravity must be moved back, and a high-aspect ratio must be used to minimize the center pressure movement in any one section. The slight washout is built in by making the dihedral break at a five-degree angle.

Two models of this design were built and flown, one a rubber job, and the other an Elf-powered gas model. For the length of motor, the rubber model turned in remarkable performance, averaging over a minute and thirty seconds. Approximately thirty flights were made with the gas model, and although it was much slower than Design No. 1, it was still too fast. The model made a number of good flights, but was far from consistent, a defect which may be attributed to structural weakness of the high-aspect ratio wing. The wings could actually be seen to flutter in flight and on one occasion broke in midair. However, tests were encouraging on the whole, and the model showed tendencies toward a fast climb and exceptional glide. A larger model with a low wing loading should turn the trick. The one weakness of the model was its slow stalling angle. A slot like that used on

FLYING WINGS REPRESENT THE THEORETICAL ULTIMATE IN AIRCRAFT DESIGN. USE THESE IDEAS, AVAILABLE AFTER A YEAR OF RESEARCH, TO DEVELOP PRACTICAL MODELS.

By Henry Cole

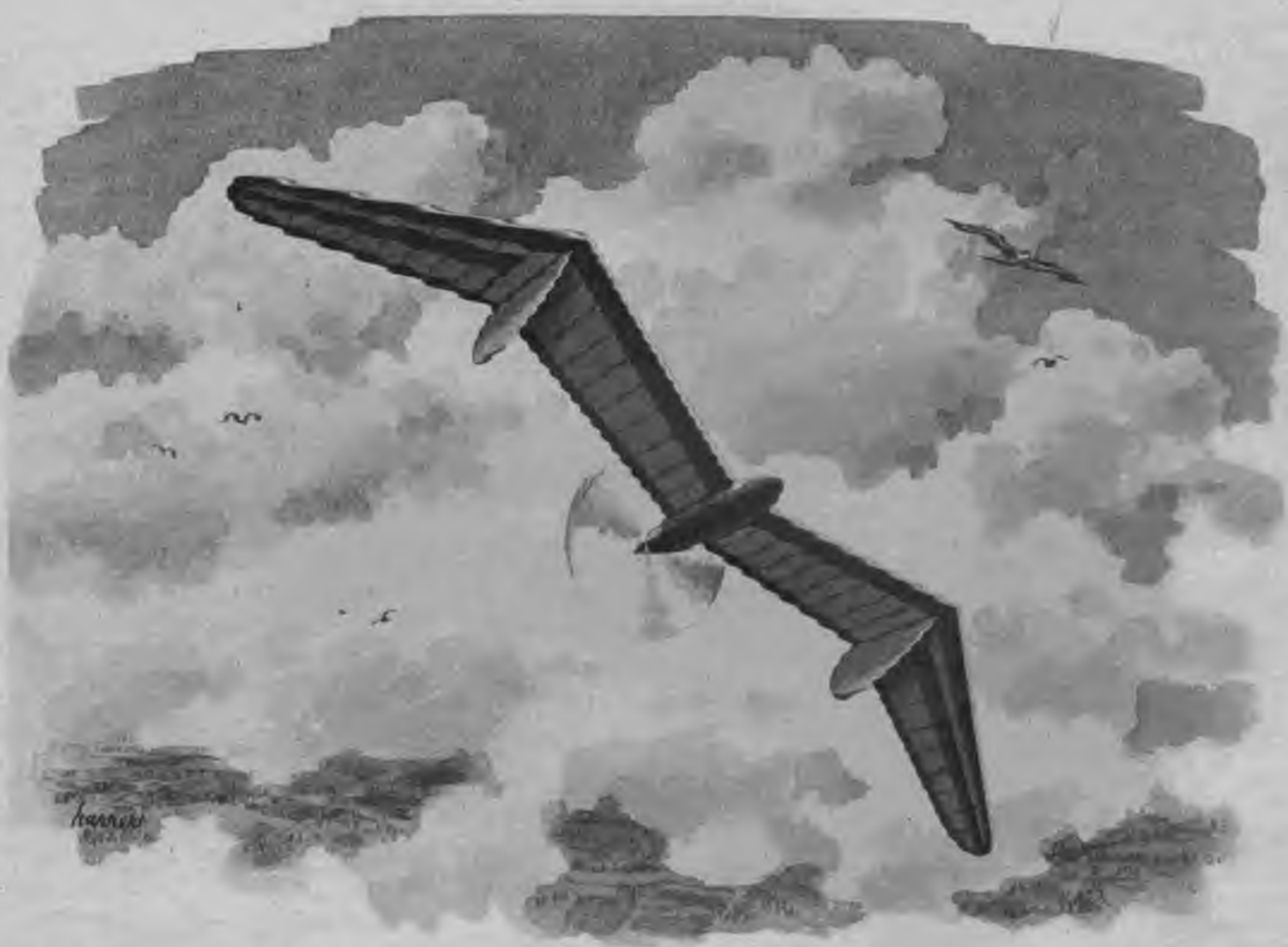
No. 1 would eliminate this undesirable characteristic and add much to the stability of the design.

Design No. 3 came directly from the birds. Through careful study of the seagull and the albatross, several new principles were discovered: (1) the flexible slotted-tip aileron, (2) the dihedral-chord relationship. The flexible tip aileron when used in connection with gull dihedral increases lateral stability by decreasing the pressure at the tips in the side slip. The spring adjustment is quite sensitive and is not advised for everyday flying. The ailerons should, instead, be locked at the proper setting. The dihedral-chord relationship on the model increases lateral and longitudinal stability. In simple terms it is the ratio of the chord to the height above the center line. Note how the chord is largest at the high point and decreases progressively in the lower sections. The albatross section used was developed through observation of the albatross as applied to the Davis airfoil formulas. Tests indicate that it is a stable section and possesses a higher lift than other stable sections of the same thickness. It has many of the characteristics of some of the N. A. C. A.'s famous five-numbered series.

At present the model has been tested only with the high start. With two strands of $^{3}/_{16}$" rubber twenty-five feet long and seventy-five feet of towline, the model shoots skyward at a fast rate, releases and sets into a slow, steady glide. The whole flight is exceptionally smooth and the model soars with all the grace of a bird. The consistency of the flights indicates that the design will make a good gas model. (The plans show the top view drawn flat for construction.)

The elements of tailless design are based primarily on three factors.

Longitudinal stability is mainly dependent upon the type of airfoil used. With stable sections a very consistent model can be produced with only small amounts of sweepback and washout. Note how little sweepback was necessary on No. 3. Some good stable sections are: N. A. C. A. M—6, U. S. A. 27, and the albatross section presented



The rubber version of this design produced flights of over a minute and a half. It proved slightly tricky as a gas job; the wings were found too weak.

first in this article. With high-lift sections more sweepback and washout must be used in connection with high-aspect ratios. Good sections are Clark Y, Eiffel 400 and Davis No. 5. Variation of the airfoil as used on No. 2 is best when using high-lift sections.

On all tailless models a small amount of washout is necessary. Adjustable tip ailerons are the best way to get this effect, for the framework often twists with the tightening of the covering and any built-in washout is lost. The most effective way to get longitudinal stability is with a large slotted aileron as used on Design No. 3. Small deflections give the desired effect and have the advantage of low drag.

The exact position of the center of gravity is best determined by experiment. Many glide tests should be made, first with a low wing loading and later with a high wing loading. Any radical changes with the C. G. should be noted and their cause determined.

Lateral stability is dependent mainly on the dihedral and the height of the center of lift above the C. G. The position of the rudders also has a pronounced effect on the lateral stability of a tailless design. Note that on all three designs rudders at the tips have been avoided because it was found that they have a detrimental effect upon spiral and lateral stability. In deciding upon the dihedral, the importance of keeping the center of lateral area low should be considered, for it determines the spiral characteristics of the airplane. In addition, excessive dihedral induces the plane to rock, causing great loss in efficiency.

Design No. 3 is a perfect example of keeping the C. L. A. low and yet incorporating sufficient lateral stability. The dihedral-chord relationship builds up a high pressure at the peak and the gull tips keep the C. L. A. low. The result is a stable model with smooth flying characteristics.

Directional control is one of the greatest problems of tailless models. Since the rudders must be placed close to the C. G., the directional moments are small unless billboard-sized rudders are used. The best solution is to place the rudders where they will be most effective without changing the lateral stability. In the case of a tractor (Design No. 1), the rudder should be placed directly in the slipstream with most of the area below the wing. In the case of pushers, the rudders must be placed outboard on the wing. It was found that the area above the wing has practically no effect, so the rudders should be placed entirely underneath the wing. The most effective place is at the points of high pressure. On No. 2 the rudder is placed on the flat section of the dihedral. The ideal setup is on No. 3, where the fin is at the high-pressure point at the peak.

Possibly sufficient directional control can be obtained by using extreme sweepback and depressed tips as on the Northrop, but the loss of lift due to sweepback is not worth the little extra drag of auxiliary rudders. The position of the C. G. is important for directional control; the most trouble will be experienced with tailless models using high-lift airfoils which require that the C. G. be moved back.

To present a complete and absolutely accurate report on a highly experimental type like the tailless design would not be possible at this time. The three designs and the discussion on stability should serve as a guide to the inexperienced designer. The increase in performance from Design No. 1 to Design No. 3 indicates that the basic ideas are sound and will eventually lead to models as efficient as the birds.

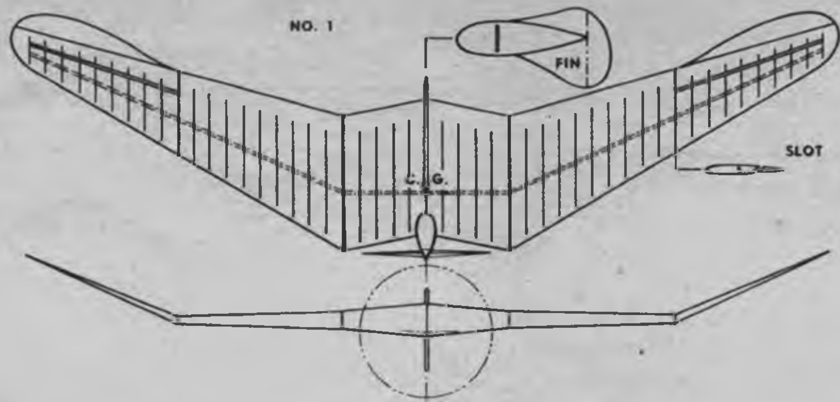
Model builders should have no illusions about developing a super contest model of this type under the present AMA rules. Conventional models are allowed a large stabilizer upon which no loading penalty is placed. Consequently, the surface loading required is twenty-five percent less on conventional models. Therefore, it is suggested that for comparison tailless models should be built with a six-ounce-per-square-foot wing loading. All of the designs presented should be scaled up for contest flying.

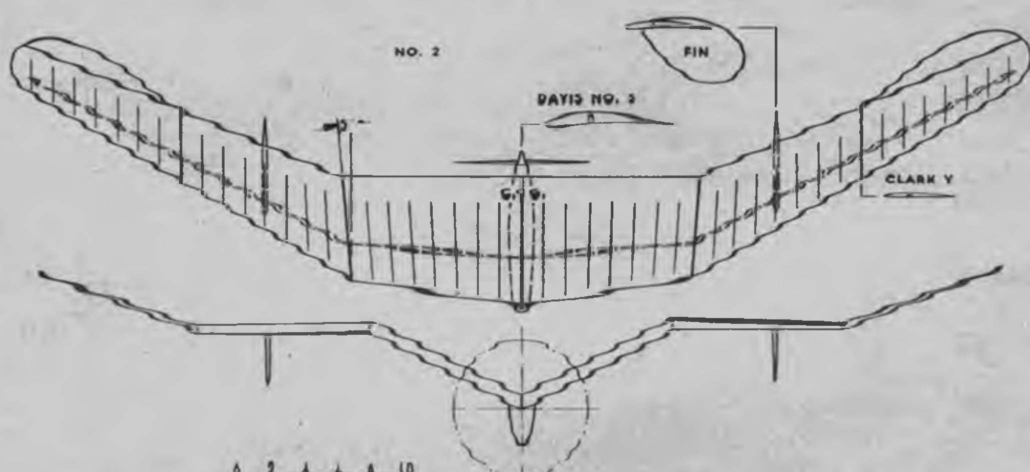
At present the tailless design does have two fields of possibility in competition, as a towline glider and in control-line speed contests. It is hard to understand why it has not been developed in these fields before, for the tailless design presents the ideal setup for soaring, the ideal setup for speed. The following recommendations can be made: No. 1 for speed; No. 2 for powered endurance models; No. 3 for towline and high-start gliders. Remember that No. 2 should be scaled up and the wing loading kept to 6 oz./sq. ft.

A complete explanation about adjustments would be too lengthy; it is advised that the builder experiment with small gliders before building the larger models. In short, the procedure is to turn the ailerons slightly up and add weight to the nose until a smooth glide is obtained. The ship is then power-flown and stalls, dives, or turns are ironed out with thrust adjustments. For towline gliders, the rudders are set for the desired turn and the towline hook is set to one side so that the model tows straight. The high-start glider should be tried by all model builders. With a well-stretched line, the model starts out at tremendous speed and climbs high overhead before releasing—and all of this without running or cranking the motor.

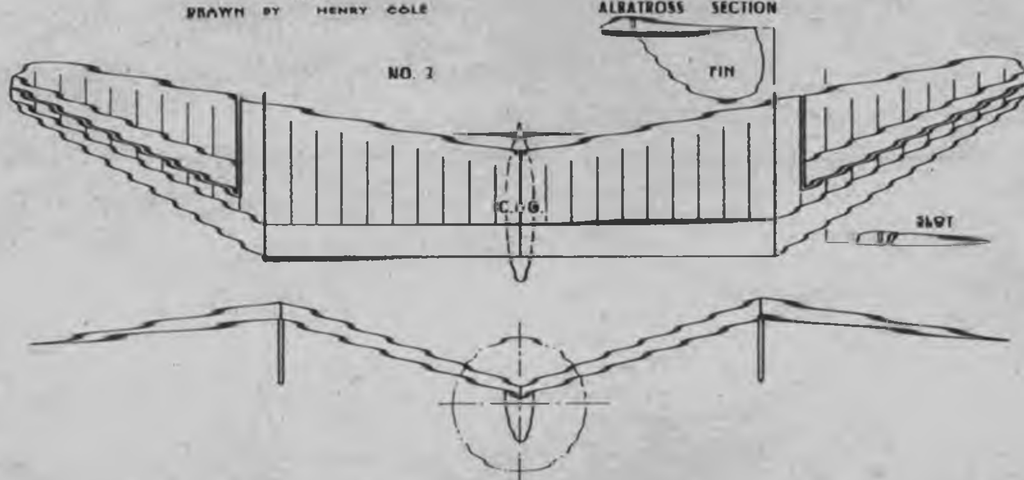
The next time you see a bird soaring high overhead, watch its slow, majestic flight and see how truly remarkable it is. Essentially a tailless model, the bird is the perfect flying machine, representing the goal which we seek.

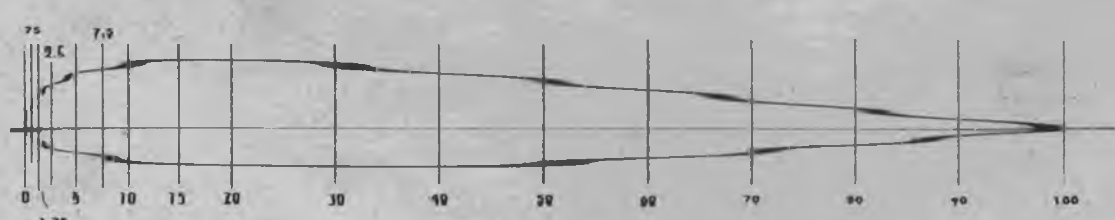
No. 3 design is recommended by the designer as adaptable for towline or hy-start gliders. Slotted aileron was found to greatly increase the model's stability.





DRAWN BY HENRY COLE





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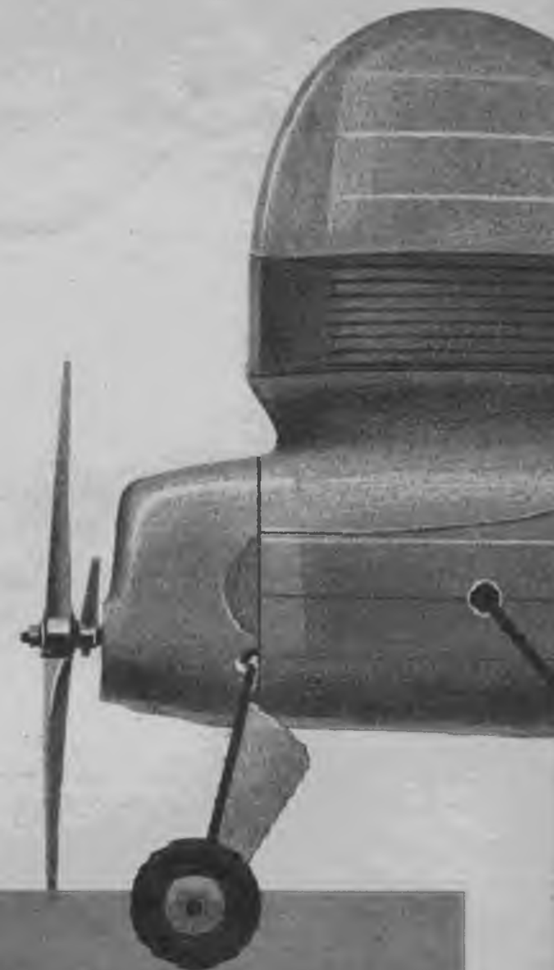
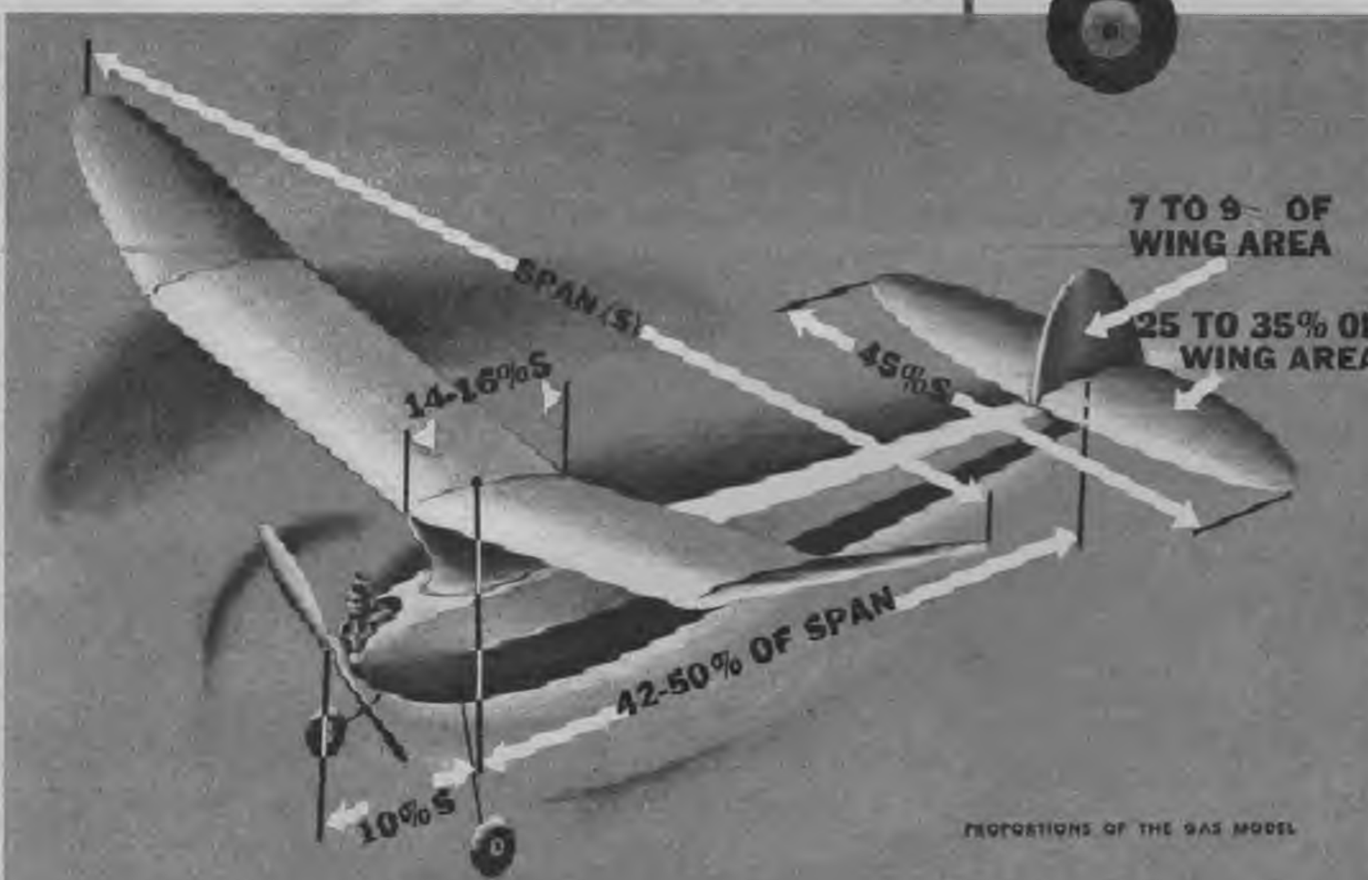
LOWER	0.00	-0.91	-1.17	-1.60	-2.20	-2.60	-2.92	-3.18	-3.44	-3.44	-3.44	-3.32	-2.77	-2.40	-1.67	-0.71	0.00

PROPORTIONS

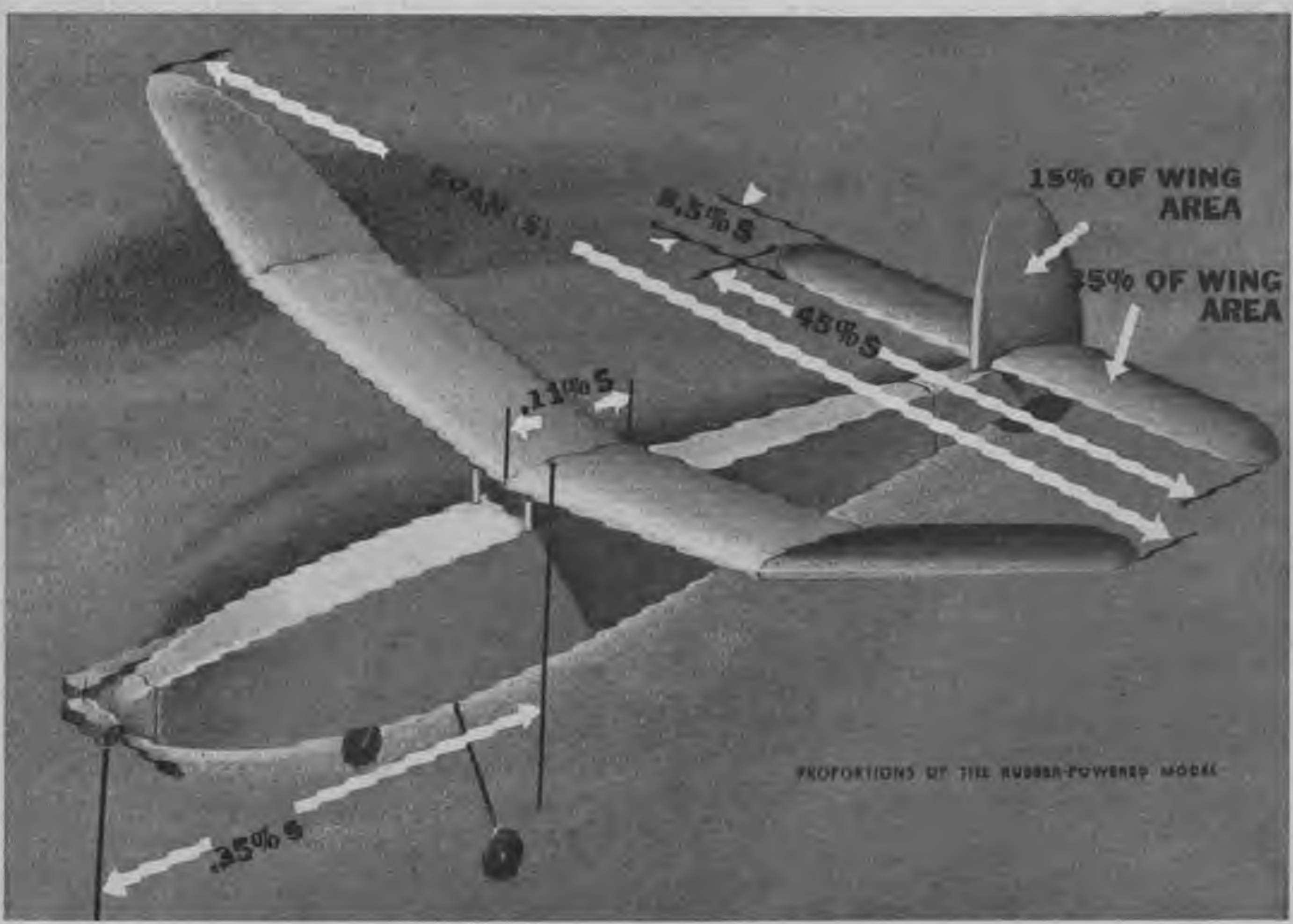
PIN THESE TWO PAGES OVER YOUR WORKBENCH. THE INFORMATION GIVEN IS INVALUABLE FOR DESIGNING NEW MODELS. IT SHOULD BE, FOR IT REPRESENTS THE FINDINGS OF MANY, MANY EXPERTS.





PROPORTIONS OF THE GAS MODEL

The side view of a model is proportioned for more than good looks. This profile is of Henry Struck's famous New Ruler. Note the location of the center of lateral area somewhat behind the center of gravity and close to the longitudinal line passing through the center of gravity. Good stunt is a cardboard profile (made on a reduced scale). By balancing it on a pin, the approximate center of lateral area can be found. For good flying, imitate Struck's general layout.



PROPORTIONS OF THE RUBBER-POWERED MODEL

DESIGN FOR SPEED

By Robert A. Hill

SIX DIFFERENT PROBLEMS ENTER INTO DESIGNING A CONTROL-LINE SPEED JOB. HERE'S ONE BUILDER'S SUCCESSFUL SOLUTION.

IT'S that last mile per hour that counts. Anyone who has done much control-line speed flying will agree that the ultimate in speed models should incorporate the following characteristics: 1. Low weight; 2. Low drag; 3. Maximum power; 4. Maximum lift per unit of wing area; 5. Controllability at all speeds; 6. Simplicity, rugged construction. The design problems confronting the designer are: 1. Weight; 2. Power-plant selection; 3. Streamlining; 4. Wing airfoil and planform selection; 5. Control methods; 6. Construction method.

With these problems in mind, the author set out to design a ship which would meet the requirements. Although it may not have those pleasing "Buck Rogers" lines, it will give stiff competition.

The problem of weight and construction was solved by turning the fuselage from basswood on a lathe and then hollowing by hand. A circular fuselage is the most streamlined, as the air pressure around it is more nearly even, which results in the least possible drag.

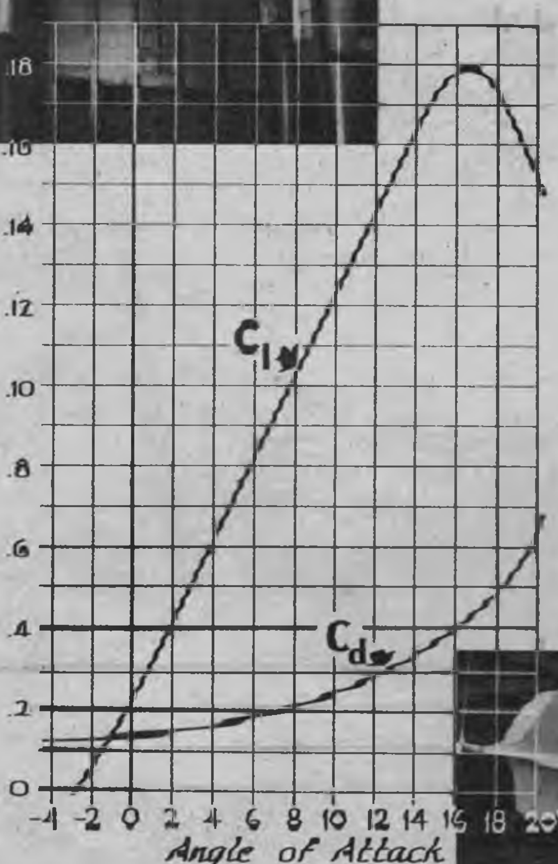
Because of the curtailment in production of model motors, the modeler will be forced to use whatever power plant is available. However, remember that good results cannot be obtained from an inherently slow-speed motor. The best propeller pitch for each individual model and motor combination can be determined only by the trial-and-error method. The author found that the best combination for his Super Cyclone was a twelve-inch-diameter gumwood propeller with a fifteen-to-eighteen-inch pitch.

Airfoil selection is somewhat more difficult. The ideal airfoil would be one which combined a high C_l max. (maximum lift coefficient) with a low D_i (induced drag). For these reasons, a modified Davis airfoil was selected.

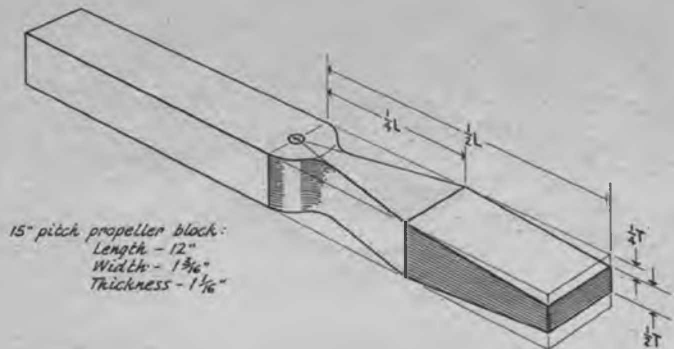
Legion are the arguments which come from the exponents of both the square and the ellipsed wing tips. The author chose to use square tips and a straight two-to-one taper ratio on both the wing and stabilizer, because, although the increased drag is negligible, the square tips provide a maximum amount of lift per unit area.

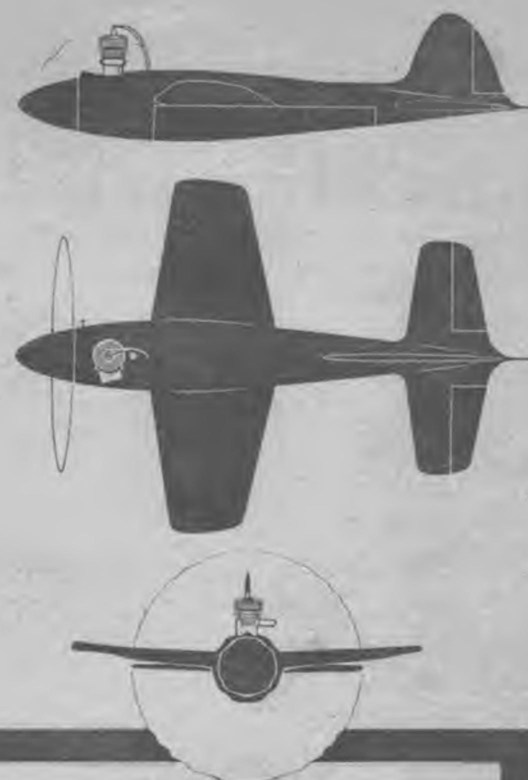
There is no ironclad rule for determining control-surface sizes. The higher the wing loading and the lower the power loading, the larger are the surfaces which would be required. Even in the cleanest of designs the landing gear contributes from thirty to fifty percent of the total drag. There are three alternatives open to the designer. They are: 1. a stationary or fixed gear; 2. a retractable gear; and 3. a take-off dolly.

With these general characteristics in mind, the model can now be laid out on paper. It is good practice to place the thrust line parallel to the longitudinal axis of the ship's fuselage. Use a longer-than-usual moment arm between the wing and the stabilizer for greater longitudinal stability. The exact design is, of course, entirely up to the modeler, but a good rule to follow is to have a definite purpose (other than increased good looks) for every part of the model.

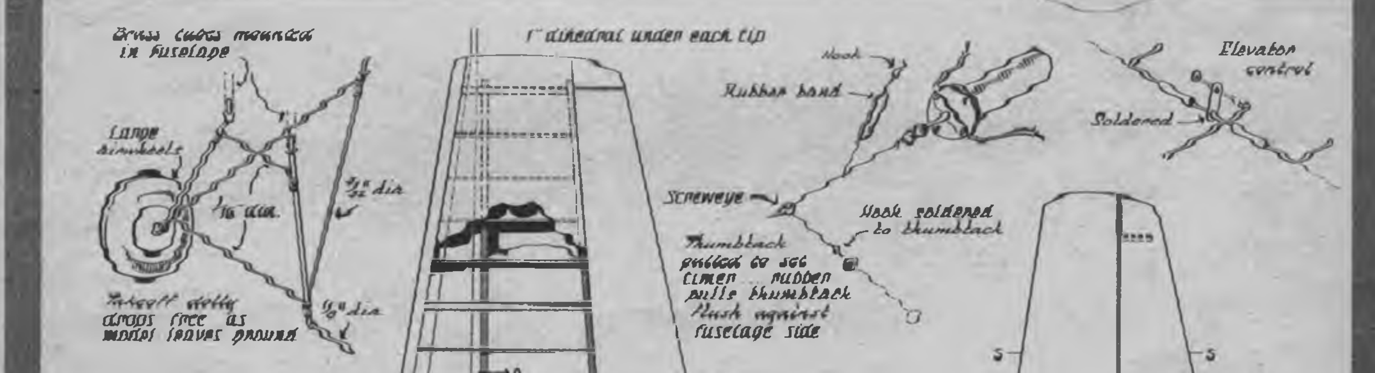


Wind-tunnel tests of this model, conducted by the author at the University of Minnesota, showed extremely interesting results: model will lift 8 lbs. (four times its own weight) at 60 m. p. h. at a 16-degree angle of attack: the lift coefficient (C_l) at 16 degrees is 1.778 and the wing does not completely stall till 24 degrees. Clean designing and a logical approach to the speed problem is reason.



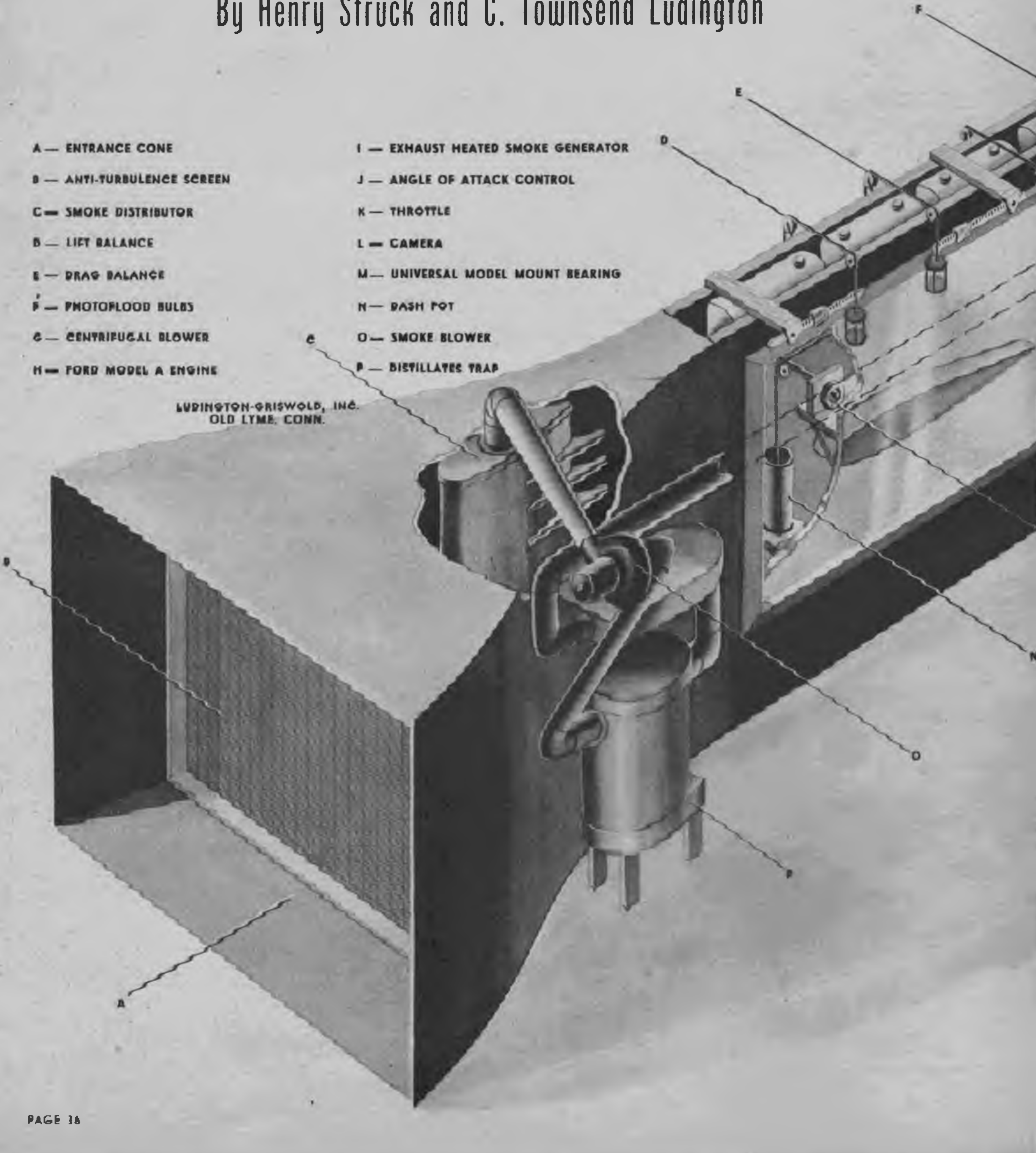


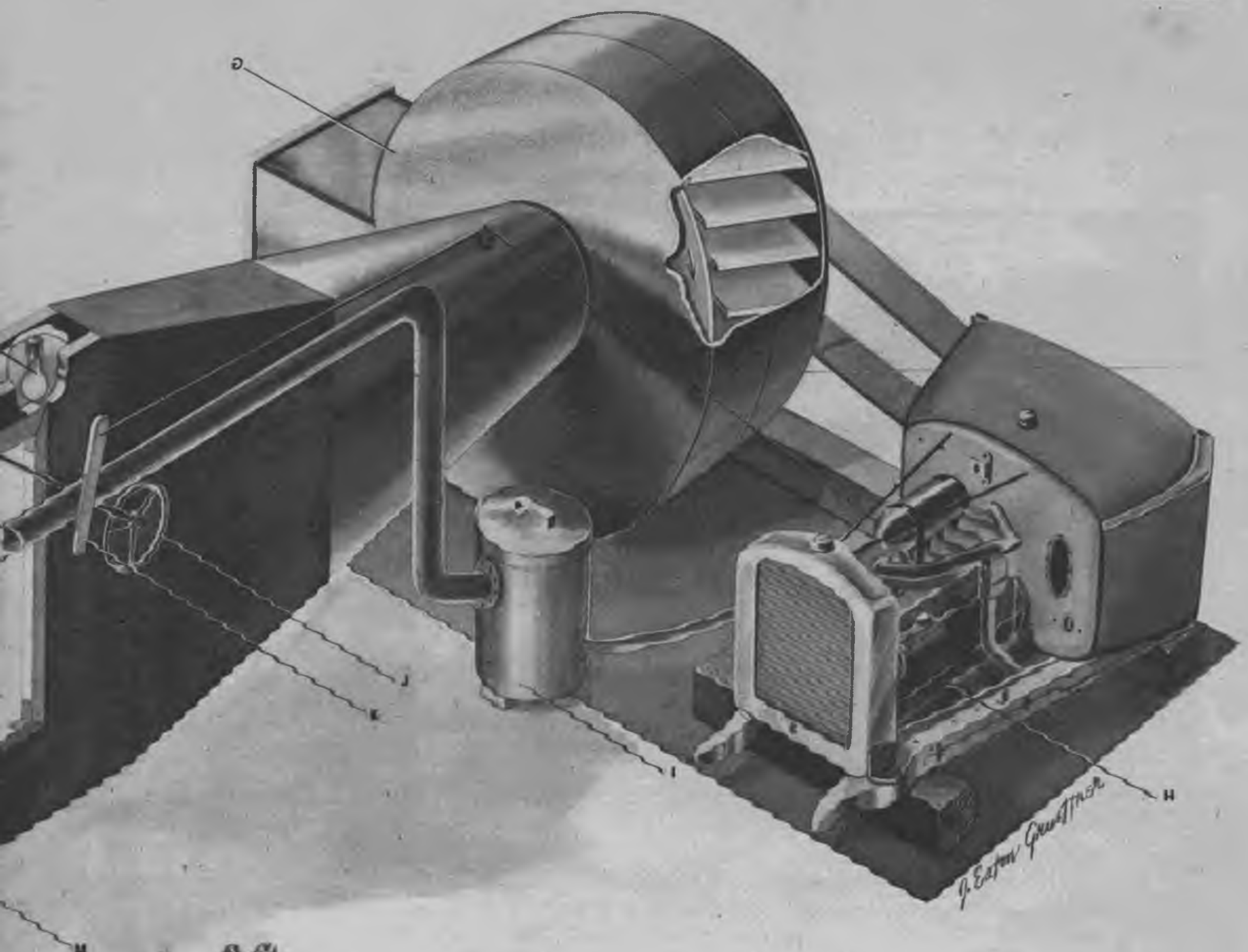
Designer Hill stresses the need for rugged construction for control-line models that are designed for speed. The basswood fuselage was turned on a lathe. The wing is a combination of a plywood spar with balsa sheet covering, the tail surfaces being basswood sheet. The planform outlines, as is apparent from the small three-view drawing, were not styled for looks, but solely for aerodynamic efficiency. Squared-off wing and stabilizer tips provide maximum lift per unit area and are structurally better than elliptical shapes. Special prop and drop-off landing gear gives the model a speed of over 100 m. p. h.



"SMOKE TUNNEL"

By Henry Struck and C. Townsend Ludington





IF we could see the air in motion—the sailor see the wind which swells his sails, the pilot see the flow of air around his plane, the model builder see the air flow over his model—the designing of bodies to move through the air would be immeasurably easier. All of us who have built models have wished we could see the motion of air around wings the way a boat designer can see the motion of the waves around a hull; then we could work out the best shape for our wings and find the best place to locate our tail surfaces in relation to the wings.

But the air is invisible, and model builders must experiment over and over until experience provides the answer—unless they find a way to make air visible.

The two-dimensional-flow smoke tunnel provides the most convenient means of visualizing air flow. The models used in such a tunnel span the entire space from front to back walls, and the air flow can move in two dimensions only—vertical and horizontal. The pictures which accompany this article were taken in the Griswold smoke tunnel, operated by Ludington-Griswold, Inc., of Saybrook, Connecticut, and are reproduced in this article through the courtesy of Coward-McCann, publishers of "Smoke Streams."

This tunnel is of the non-return-flow type. A blower draws in air through the large square entrance cone, in which are several wire and cheesecloth screens to smooth out the flow. Then the tunnel narrows down to the test area, six and a quarter feet high by seven feet long by four inches wide. The models, in a field of twenty-four smoke streams, are observed through a heavy plate-glass window in the front wall, two and a half feet by four and a half feet, mounted flush with the inside face of the tunnel. On the rear wall is the model mount, a steel bar connected to lift and drag balances through a universal mounting. By means of the mount the models can be rotated in the air stream to any desired angle of attack, and small

"SMOKE TUNNEL"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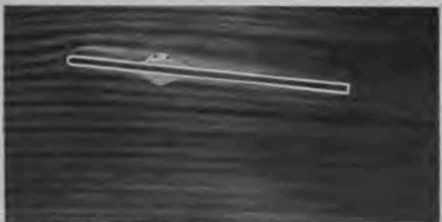
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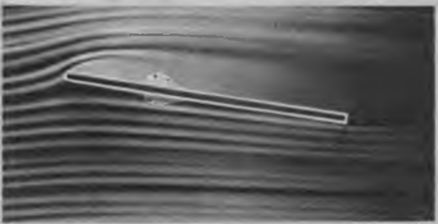
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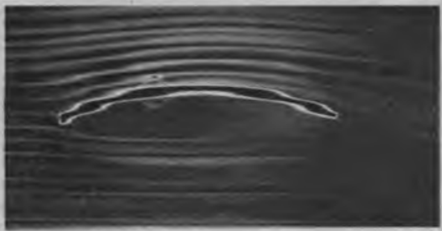
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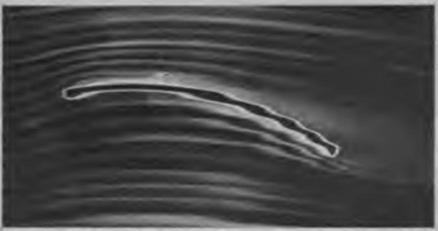
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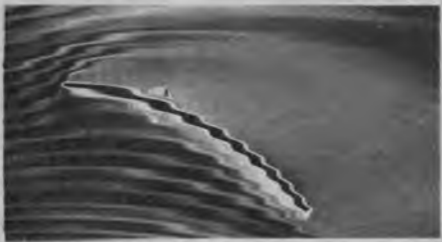
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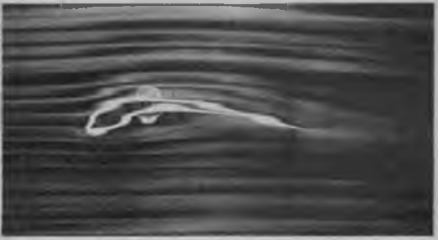
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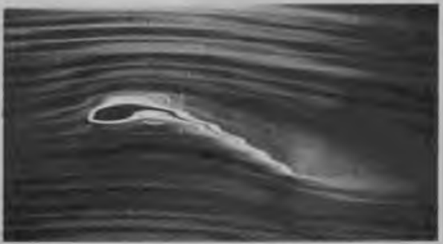
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cables run from the end of it to balances outside the tunnel so that lift and drag forces can be measured. After the test area the tunnel widens again to a square exit, much smaller than the entrance, through which air and engine exhaust are discharged together.

A Model A Ford engine drives the large centrifugal blower and also provides heat for the smoke-supply apparatus, a closed stove containing a heater unit. The engine exhaust passes through the heater unit before being discharged into the exit. To make a slow-burning fire which will create smoke, rotten wood is used in the stove. An ordinary stovepipe carries the smoke to the radiator, where it is cooled and the tar distillates condensed. After that it goes through a water trap in which most of these distillates are collected, and from there to the intake of the blower, which forces it through a throttle valve into the smoke-distribution system.

The smoke-distribution system is in the entrance cone. It consists of a vertical streamlined tube pierced at one-inch intervals by twenty-four short horizontal tubes in the trailing edge.

On the front face of the tunnel is mounted an inclined U-tube manometer calibrated in miles per hour. With it is connected a pitot-static tube located in the air stream.

TOP-SURFACE LIFT: Most of us know that the principal thing which keeps an airplane flying is the fact that air moves faster over the top of a wing than it does over the bottom. This is particularly true of a section highly cambered on the upper surface. In 1738 Bernoulli discovered the principle which bears his name—namely, that pressure of air or water on a surface is lessened the faster it moves over that surface. Therefore, airplane wings are designed so that the air flows faster over the top. This means that the pressure on the upper surface is less than the pressure on the lower one, and the result is a lifting force.

Figures 1 to 23 are pictures of experiments showing lift and stall characteristics of various wing sections. In studying the air flow over the models, it is important to keep in mind that narrow and converging smoke streams indicate high velocity and reduced static pressure; wide, diverging smoke streams, on the other hand, show decreased velocity and high static pressure.

Figures 1 and 2 illustrate what we might call top-surface lift. An airfoil section hinged at the leading edge and loose at the trailing edge is placed on top of a flat plate. In Figure 1 there is no flow of air; in Figure 2 the air flow, and the smoke streams which are part of it, is passing rapidly over the top surface of the airfoil. The plate prevents any air flow over the bottom surface, although, of course, static pressure exists there. Notice that the trailing edge of the airfoil is lifted a considerable distance above the plate.

When we built kites or the simplest form of baby R. O. G. models, we achieved a result similar to that in Figures 3, 4, and 5. The three pictures show a flat surface in the air stream at angles ranging from about 2° to 30°. Notice that the flow over the top surface of this flat plate breaks away at quite a low angle. The point at which the top-surface flow breaks away is the stalling point. When this happens on the wing of a model, it must dive to regain speed and re-establish smooth top-surface flow.

After we had built and flown models with flat wings, most of us made similar ones with wings evenly cambered on both top and bottom, or with wings covered on the upper surface only. These were similar to the pictures in Figures 6, 7, 8, and 9, showing the flow of smoke streams over a curved plate. It is apparent that in Figure 6, where the angle of attack is 0°, the flow over the bottom surface is actually stalled, but there is some lift due to the considerable acceleration of the flow over the top surface. It is interesting to note that as the angle of attack is increased, this section "hangs on" longer than the flat plate. In other words, the top-surface flow does not break away until the model reaches a considerably higher angle than the flat plate reaches.

STALLING POINT OF AIRFOIL SECTIONS: Many model builders, as they began to make outdoor rubber-powered or gasoline-powered models, have used highly cambered wings somewhat similar to the bird's wing section, covered on top and bottom, of Figures 10, 11, 12, and 13. In most cases the wings used were not so violently cambered on the undersurface. The smoke streams show that this section, while not suitable for high speed, can reach a very high angle of attack before stalling.

Figures 14 and 15 show that an NACA 23009 section has a rather early and very abrupt stall. Such a thin section has often been used for wing tips. Model builders who have used double-cambered wings with a thick section at the root and a thin section at the tip, have noticed the tendency of such wings to stall first at the tips and to fall off into spins.

The NACA 23015 section is shown in Figures 16 and 17. Note that there is an increase in angle of attack over that of NACA 23009 before the stall occurs. Also, it is interesting to note how far ahead of the wing the smoke streams are affected. The point at, or just below, the leading edge, where the streams are wide and diverging, is known as the stagnation point. In theory this is the point at which particles of air are brought to rest and then accelerate violently over the top and bottom surfaces—more violently over the top.

LOCATION OF STABILIZERS AND ELEVATORS: The location of the stabilizer and elevators with relation to the location of the wing itself is of vital importance. Probably there is no such thing as a perfect relationship to cover all situations. Figures 18 and 19 show a high-wing and a low-wing monoplane at a high angle of attack. In the case of the low-wing monoplane (Figure 19), the smoke streams are striking the stabilizer at an angle which shows that the latter is stalled. Violent tail buffeting would occur at this moment.

Landing flaps which have been lowered have much the same effect on air flow as wings of very high camber. Figures 20 and 21 show the effect of lowered flaps on high-wing and low-wing monoplanes.

WING-TIP VORTICES: Another factor which must be considered in the design of wings and their relationship to the rest of the airplane is the phenomenon known as wing-tip vortices. Because the pressure over the top surface of the wing has been lessened with respect to the surrounding air, there is a tendency for air flow over this surface to converge toward the trailing edge. Positive pressure on the lower surface makes the air flow over the bottom diverge toward the trailing edge. As the two streams come together at the wing tip, vortices are produced, as shown in Figures 22 and 23. These pictures illustrate that an airplane in a steep side slip may run into a condition where the vortex from the lower wing strikes the stabilizer on the lower side. As flow along the upper side of the fuselage is very much disrupted under these conditions, the upper side of the stabilizer will be doing very little work anyway. Such a situation may bring about almost complete loss of stability.

Note: Unless otherwise specified, all pictures were taken at an air speed of forty miles per hour. In interpreting them it should be borne in mind that a model in a two-dimensional low-wind tunnel stalls at a higher angle than an actual wing section in free air.

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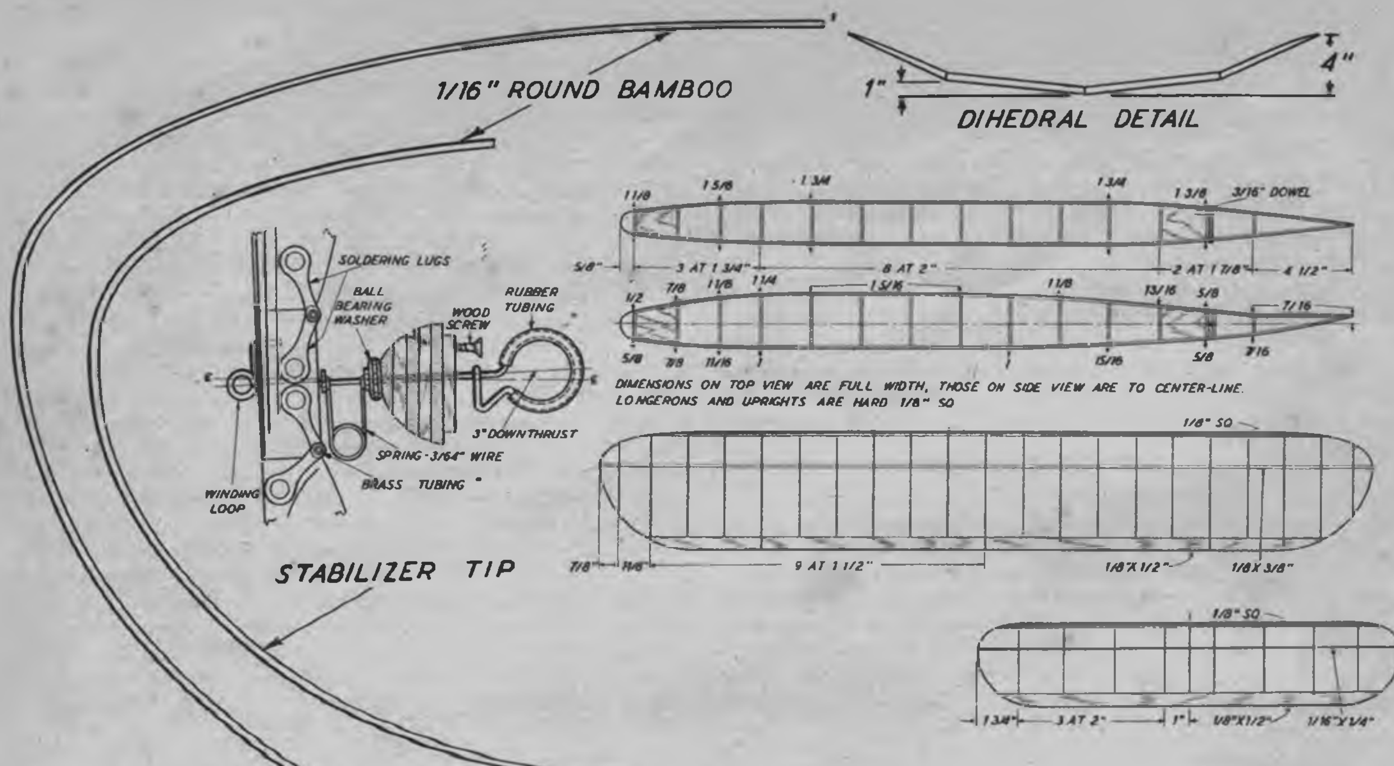
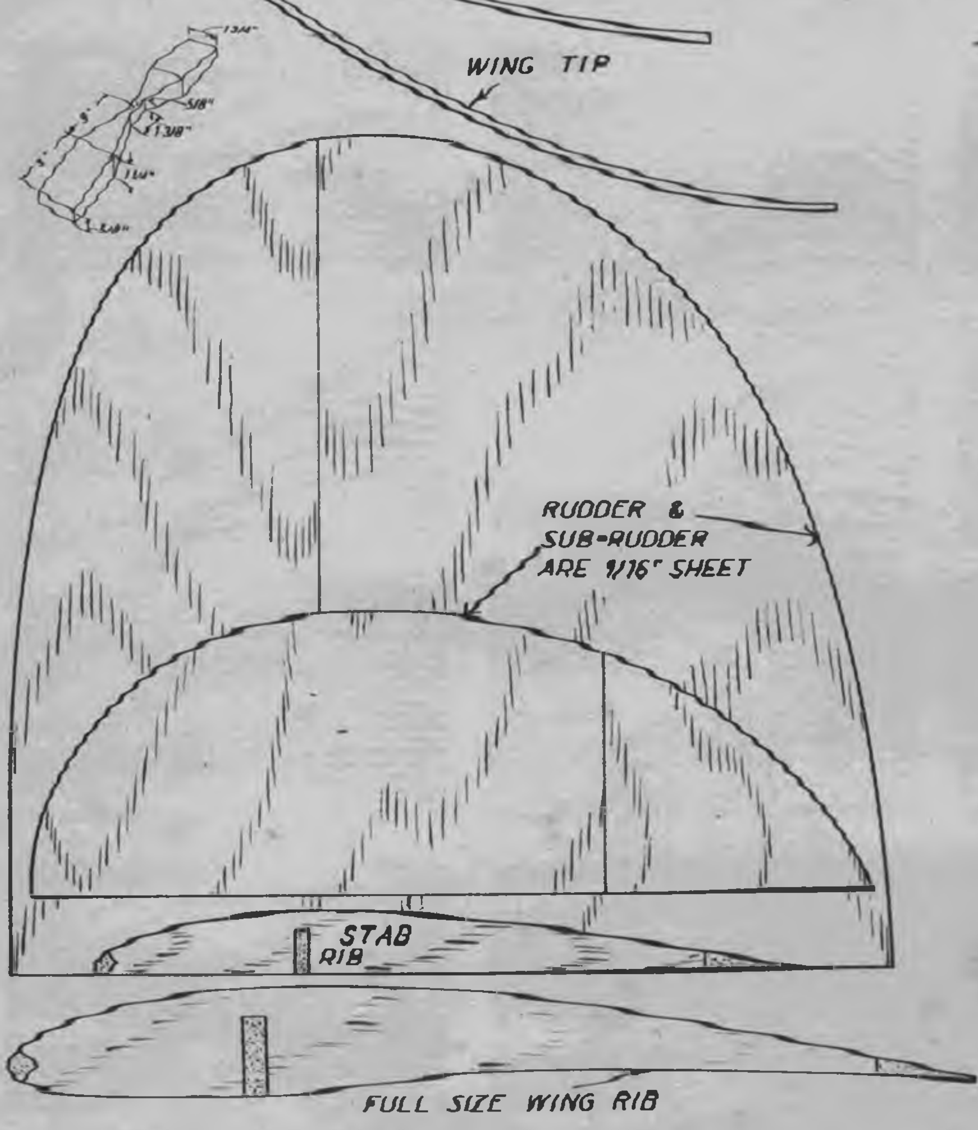




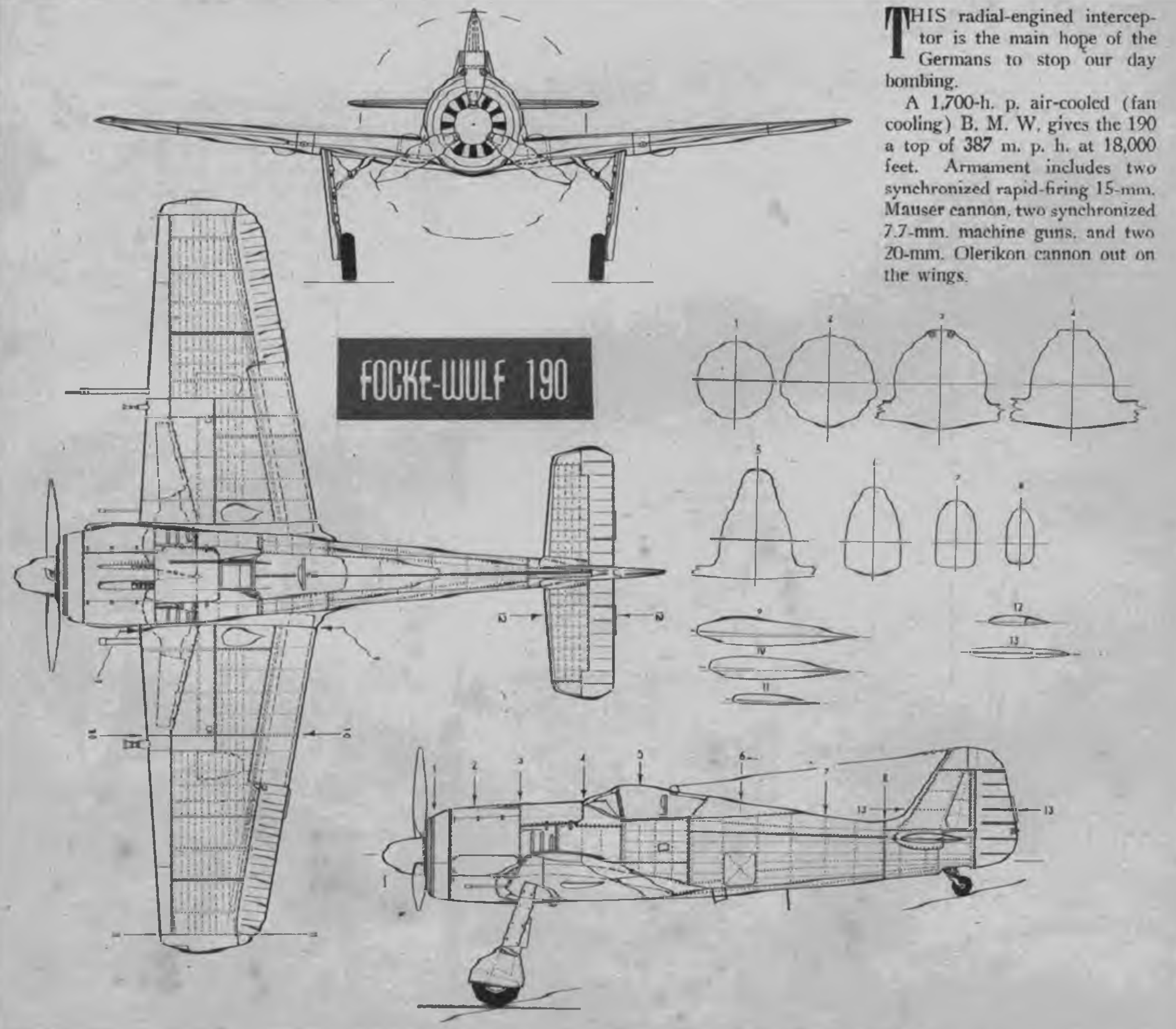
GOLLYWOCK

By Wally Simmers

PLACING high in contests is an old habit of the Gollywock which started back in 1940 when she took second place in the open-class stick event. She's many more records to her credit by now, both national and local. Simplicity of construction and easy adjustment is the secret! You can build one the night before the contest and lose it the next day —but with the present material shortage, use a simple rudder type of dethermalizer.

Construction is simple, and requires little description. The cross section of the stick is rectangular. Fill-ins at the nose and tail are $^1/_{16}$" sheet. Carve the prop in the usual manner, with about $^3/_{32}$" under camber at the widest part of the blade. The hub is left rectangular to facilitate mounting of the folder. $^3/_{32}$" O. D. brass tubing makes an ideal hinge pin. Power with 16 strands of $^3/_{16}$" flat, with six or more inches of slack. Adjustments are few. A $^3/_{16}$" incidence block is placed under the L. E. of the wing. Use three degrees down, and one degree right thrust. Right turn in the rudder provides circle in the glide.

Air Trails Plan Book

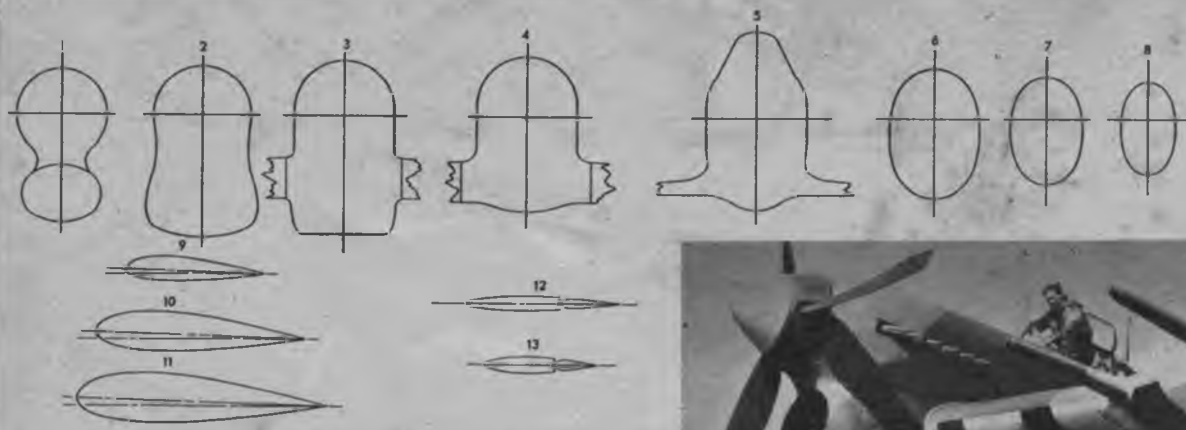


THIS radial-engined interceptor is the main hope of the Germans to stop our day bombing.

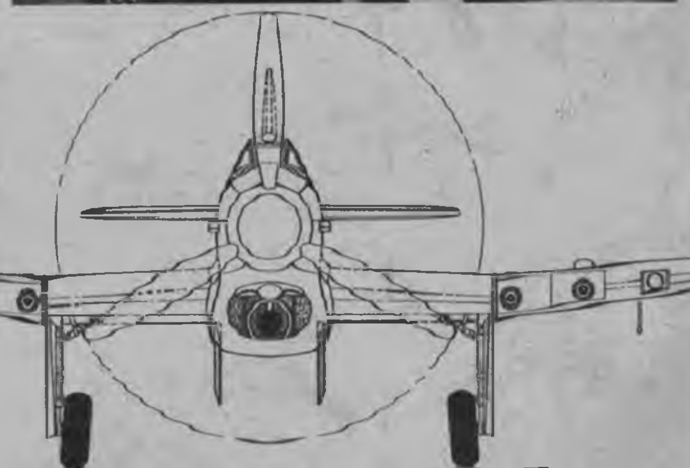
A 1,700-h. p. air-cooled (fan cooling) B. M. W. gives the 190 a top of 387 m. p. h. at 18,000 feet. Armament includes two synchronized rapid-firing 15-mm. Mauser cannon, two synchronized 7.7-mm. machine guns, and two 20-mm. Olerikon cannon out on the wings.

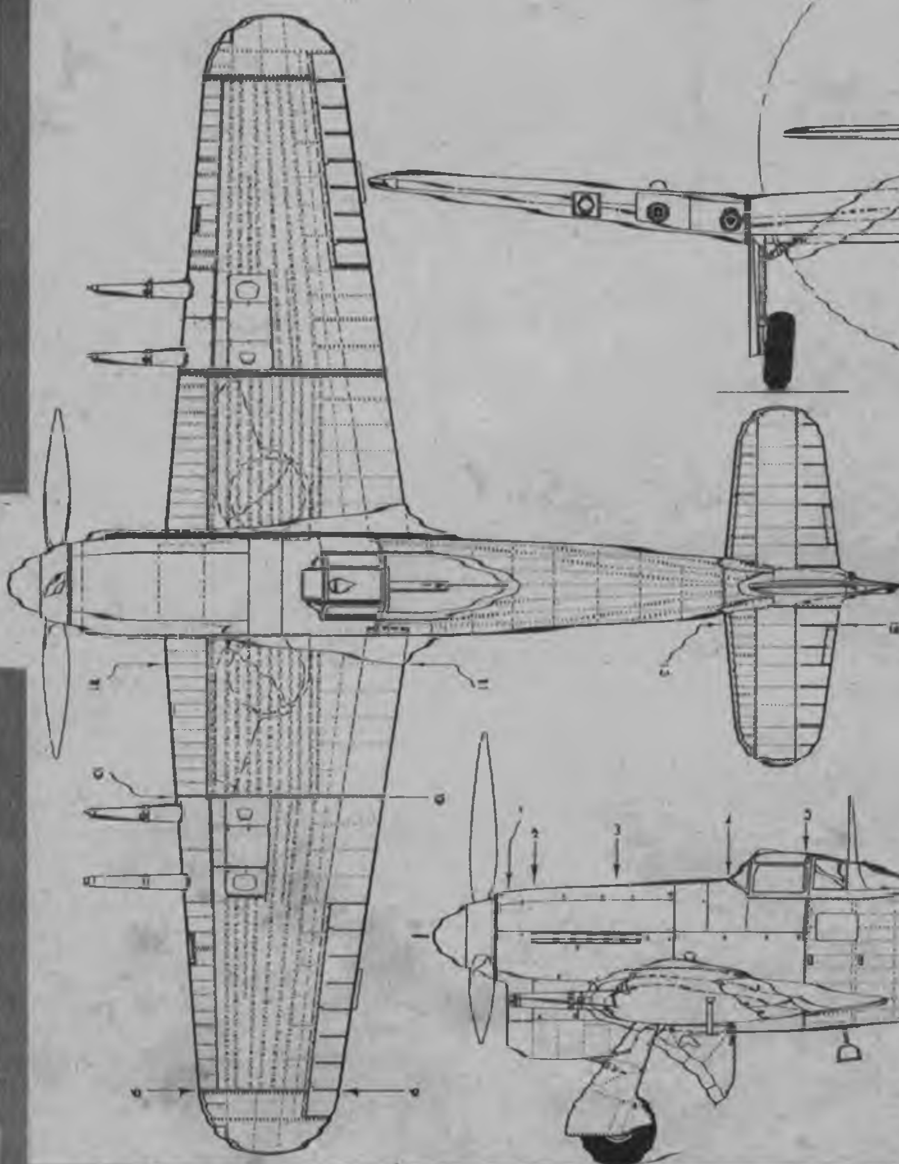
BOEING FLYING FORTRESS, B-17G

A MORE deadly variation of the famous B-17 bomber, is the new B-17G, the eighth member of the distinguished Fortress series. The "something new" that has been added is the "chin turret," armed with two .50-caliber machine guns, which gives it a total of approximately twelve guns of all makes, making it a tough opponent to tackle. The heart of the Fortress is its turbo-superchargers which, when combined with the four 1,200-h. p. air-cooled Wright Cyclones, give a service ceiling of over 29,000 ft. Its bomb-load capacity is now said to exceed that of the Lancaster, and recent photographs show a "block buster" mounted externally under each wing. Dimensions: Span, 103 ft.; length, 73 ft. 9 in.

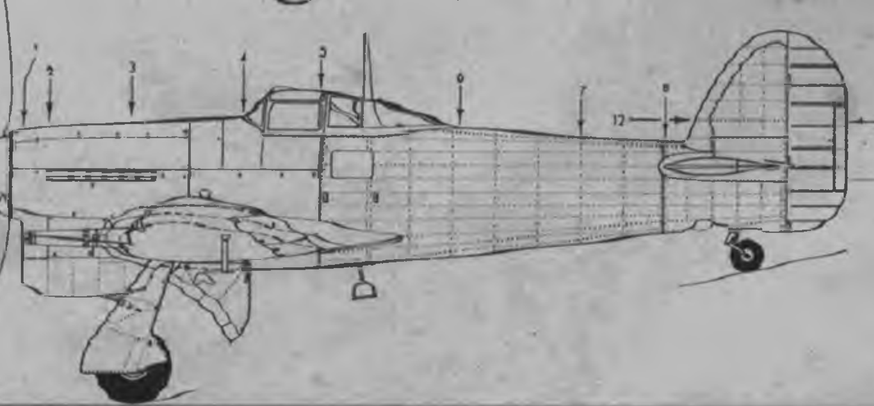


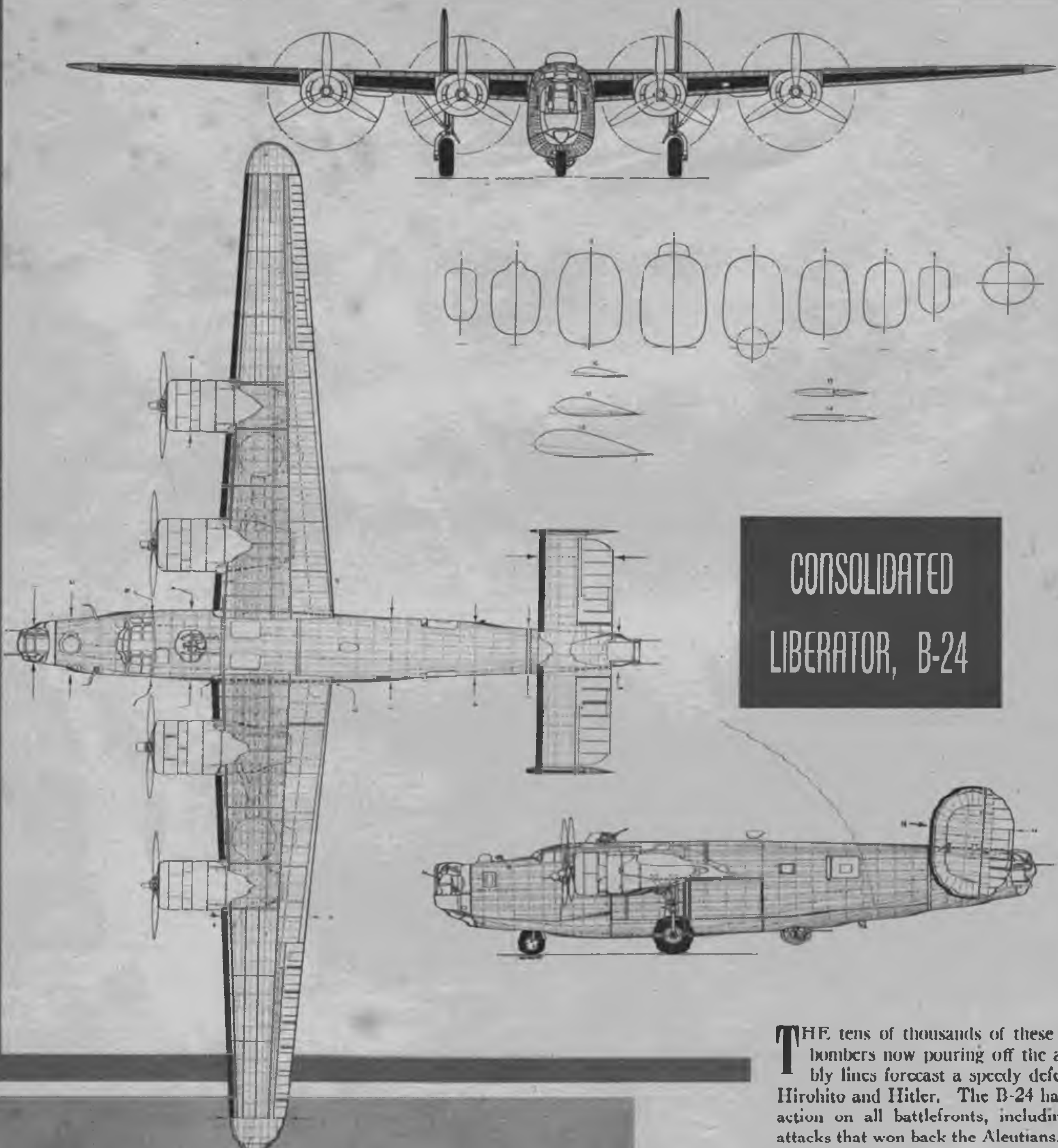
HAWKER TYPHOON





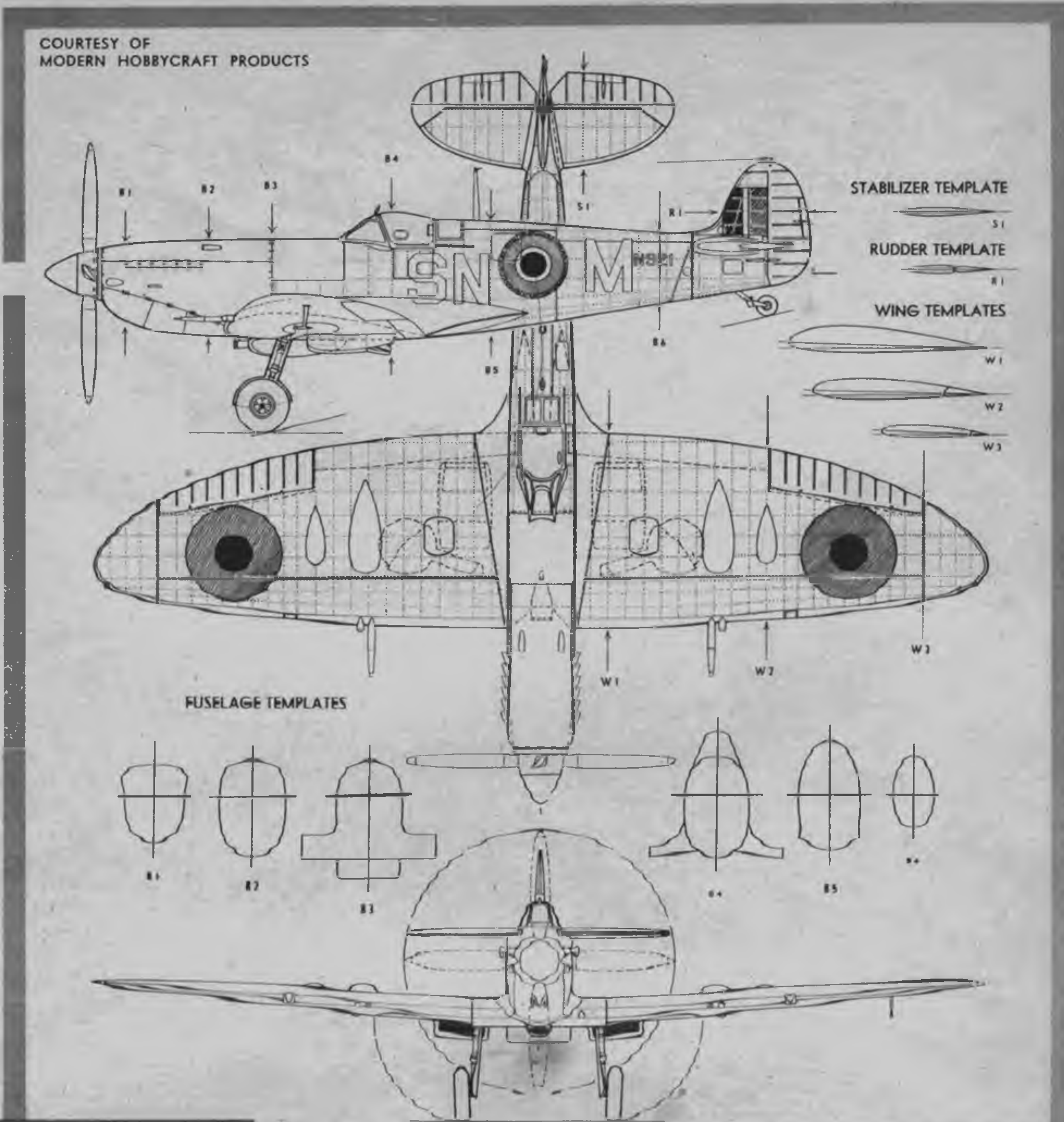
BRITAIN'S fastest fighter, the Hawker Typhoon is designed for low- and medium-altitude work. It is a formidable fighter bomber with four 20-mm. cannon and a pair of 500-lb. bombs, one under either wing; it beats up the German railroads, power stations, and coastwise shipping. As a fighter, its chief success has been against the fleet Messerschmitt Me-210s, which rely on great speed to get away with their "tip-and-run" raids. The Typhoon can overhaul the 210.





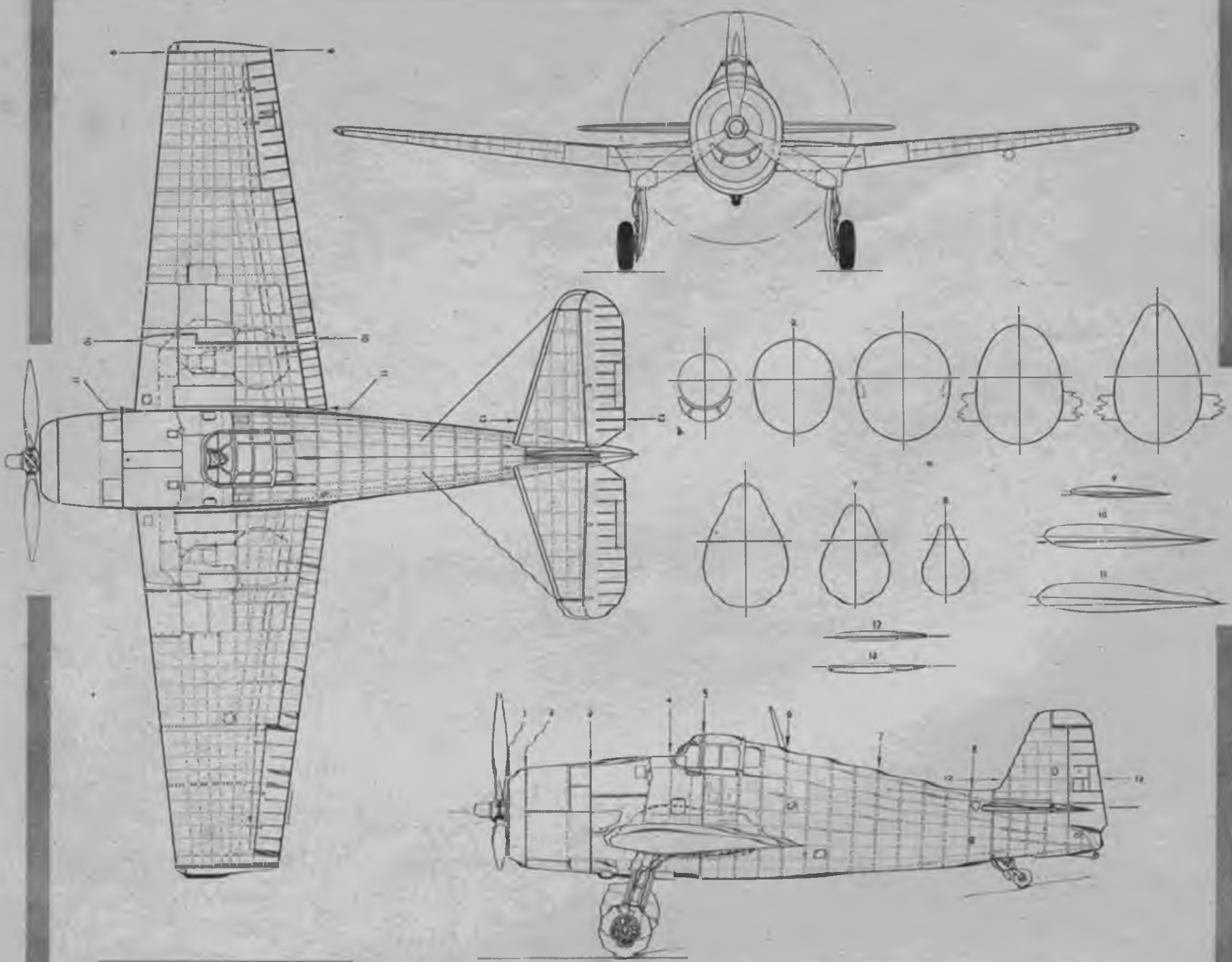
CONSOLIDATED LIBERATOR, B-24

THE tens of thousands of these heavy bombers now pouring off the assembly lines forecast a speedy defeat for Hirohito and Hitler. The B-24 has seen action on all battlefronts, including the attacks that won back the Aleutians. The Liberator holds the record for the Atlantic crossing (six hours and twelve minutes), as well as the Pacific crossing. Don't let its ungainly appearance on the ground deceive you, as its top speed is over 300 m. p. h., with an approximate range of 4,000 miles. Credit the high-aspect-ratio wing, Davis wing section, and four turbosupercharged Pratt & Whitney Twin Wasps for this performance. A crew of six to ten men and a bomb load of four tons are taken along for the ride. Newer models include waist guns, belly turret and a two-gun nose turret. Twelve to fourteen guns are carried in all—the exact information being restricted. Span, 110 ft.; length, 63 ft.



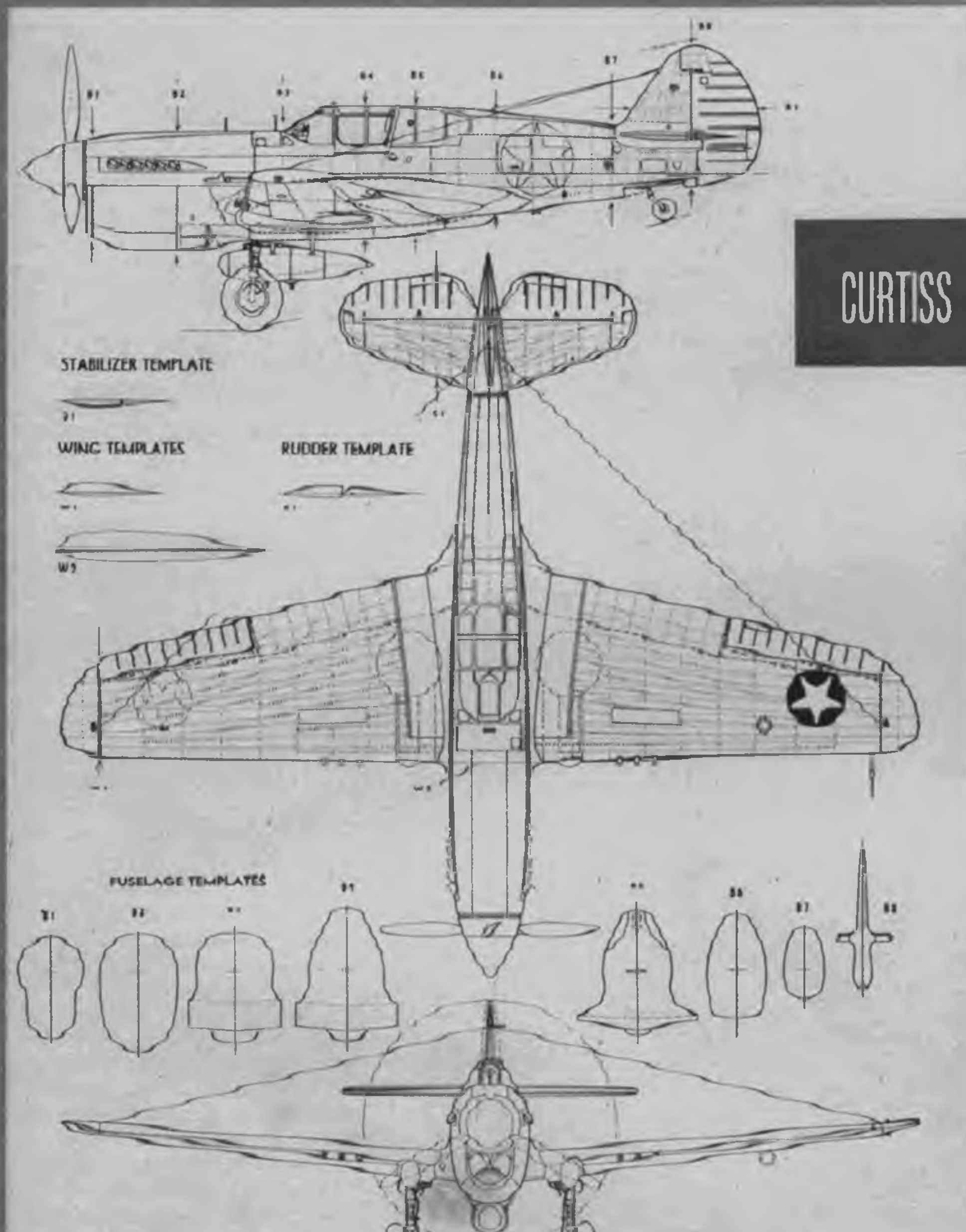
SPITFIRE IX

THIS versatile and beautiful airplane is remarkable for the manner in which it has maintained its supremacy over competition. Not to be confused with fighters like the Thunderbolt, because one is an interceptor and a defensive machine and the other a convoy fighter or offensive machine; the Spitfire is a top-notch carrier fighter as well as land-based interceptor. The Spit's design can be appreciated from the fact that it was first tested in 1936. The original version had eight .30-caliber guns. Armament varies to four 20-mm. cannon. The latest Spitfire, the "Nine," has a two-stage supercharged Merlin with a four-bladed propeller. Power is in excess of 1,500 h. p.; speed, close to 400 m. p. h.



THE HELLCAT

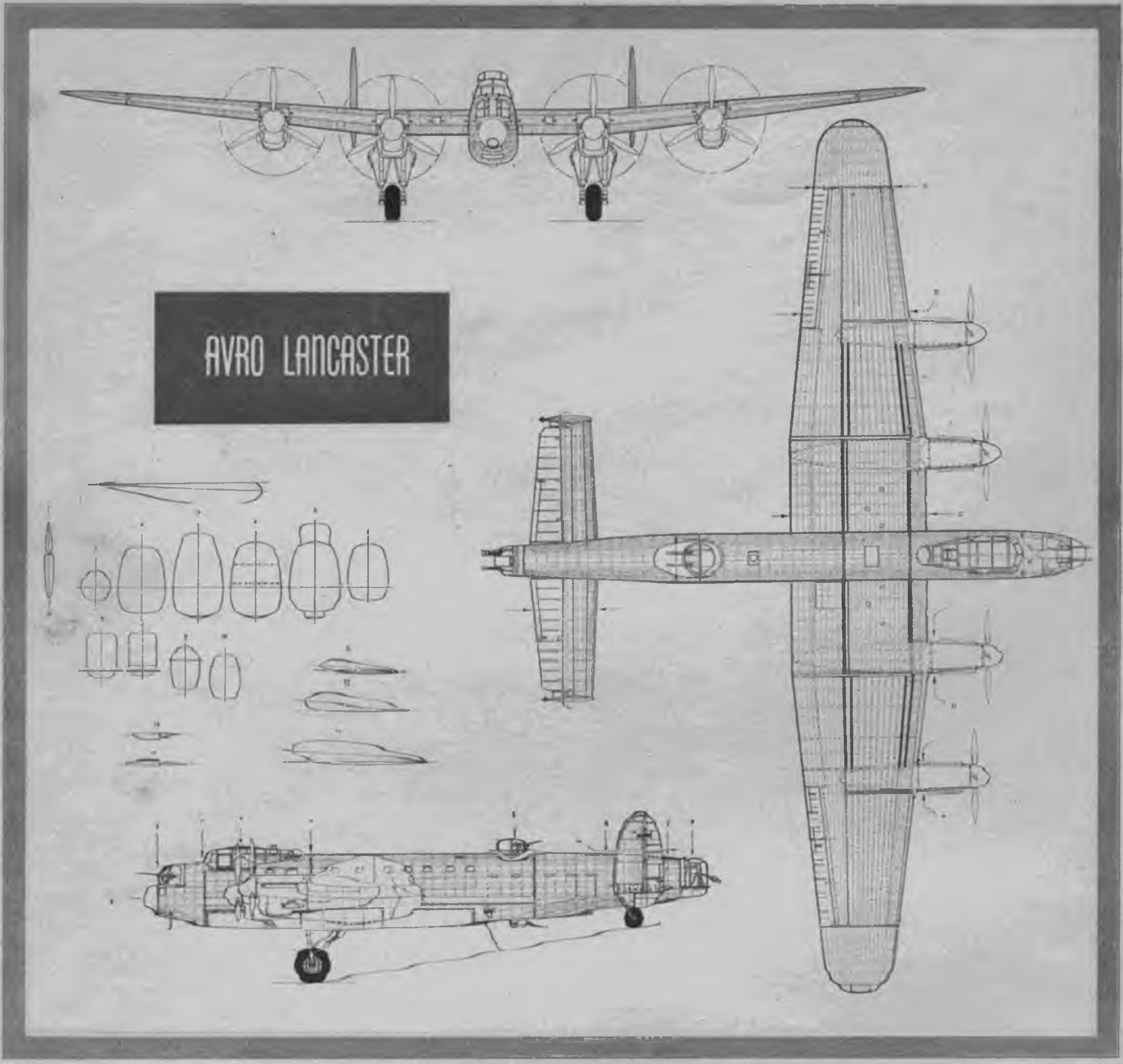
CONVINCING proof of the capabilities of this new Grumman shipboard fighter, the Hellcat, or F6F, is the statement of some British pilots who fly Seafires that they prefer the Hellcat. Indeed, the Hellcat, successor to the Wildcat, has probably the finest maneuverability of any modern fighter. It has many other strong points to give the enemy a bad surprise. Though typically Grumman, the Hellcat has features which distinguish it from the Wildcat. It is a low-wing, and is bigger and more powerful than the old F4F. Its landing gear is wing mounted and retracts P-40 style, the struts rotating and swinging back and up, so that the wheels fit flush into the wing. The Hellcat was designed after many talks with navy fighter pilots and is the first fighter in this country to have the full benefit of actual war experience from the ground up.



COURTESY OF MODERN HOBBYCRAFT PRODUCTS

CURTISS WARHAWK, P-40F

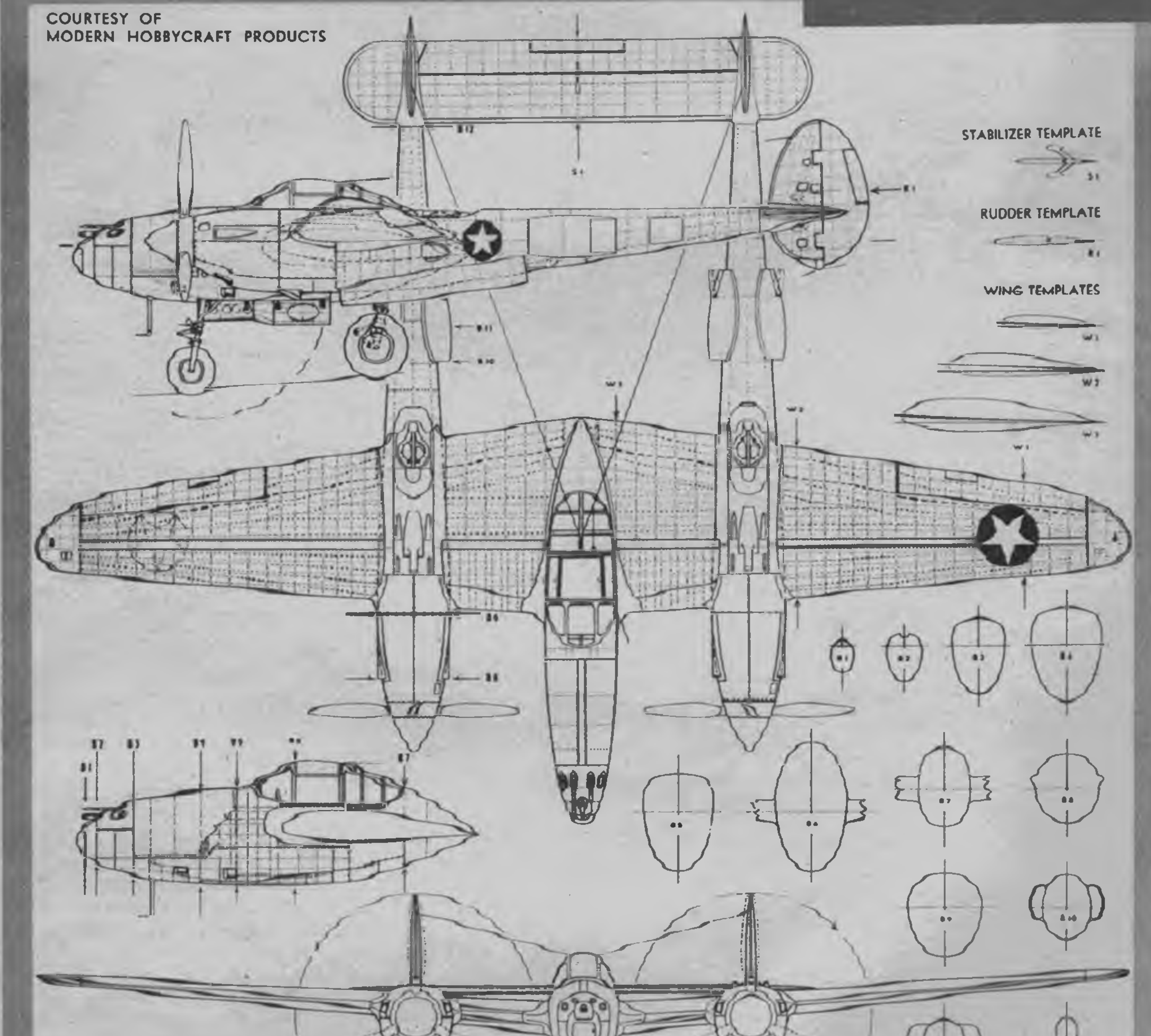
OVER 10,000 of these tried and true Curtiss-Wright P-40s have been built. They have been in service with almost all the Allies and in nearly every theater of war. Amazing things have been done with this veteran, including sinking of a Jap cruiser in the Philippines and the low-level bombing of Rommel's armor that knocked the German African offensive out of kilter. However, the most famous record of all was that run up over the Japs under the adept handling of the Flying Tigers under Chennault. Designed for the Allison, which was used in the Tomahawk and Kittyhawk, the P-40 Warhawk has the Packard-built Merlin. The P-40 series, like the Bell, is a low- and medium-altitude fighter and should not be compared with highly supercharged high-altitude ships.

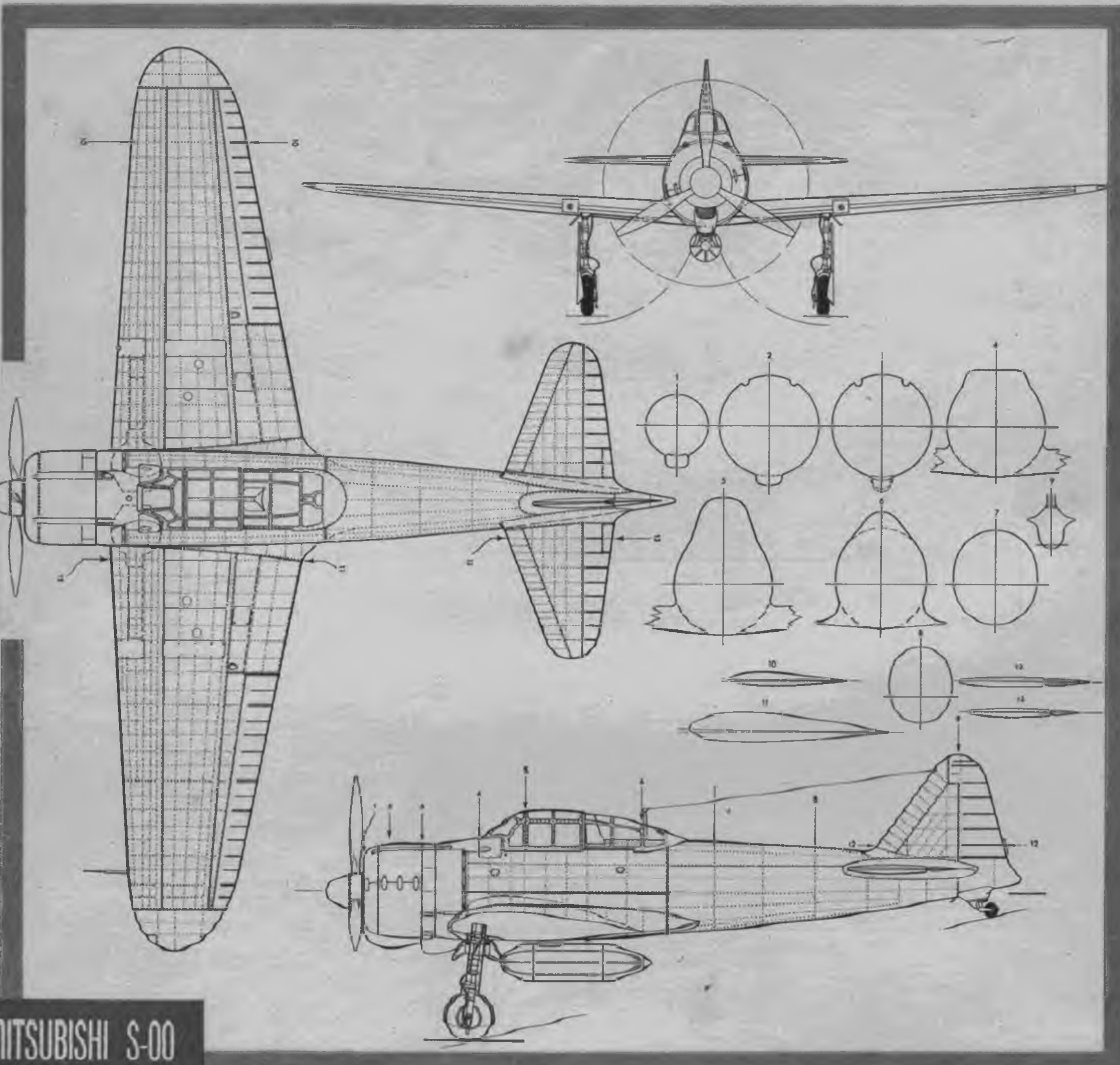


THE Avro Lancaster is Britain's best heavy bomber. The British claim it is the world's best, while we think the Fortress is; but regardless of this difference of opinion, the fast, maneuverable Lancaster is one of the best bombers ever built. This design was planned in 1936, years before the war, and was a development of the now obsolete Manchester. A larger wing, four Rolls-Royce Merlins instead of Rolls-Royce Vultures, were the main improvements. Structurally, it is an extremely simple airplane, very adaptable to mass production and is produced throughout England and Canada.

ONE of the war's most brilliant fighters, the Lockheed Lightning has confounded its critics. Turbosupercharged, it excels at high altitudes. Powerful, fast, and heavily armed, it is also an excellent strafing machine. Long range makes it a good convoy fighter. With two big teardrop auxiliary tanks, slung under the wing between fuselage and booms, it can fly the ocean to England. The nose armament of four .50-caliber guns and one 20-mm. cannon fires faster because synchronization is not required. Since guns do not converge (lines of fire are parallel), they are effective at all ranges. Two 1,150-h. p. Allisons.

LOCKHEED LIGHTNING, P-38



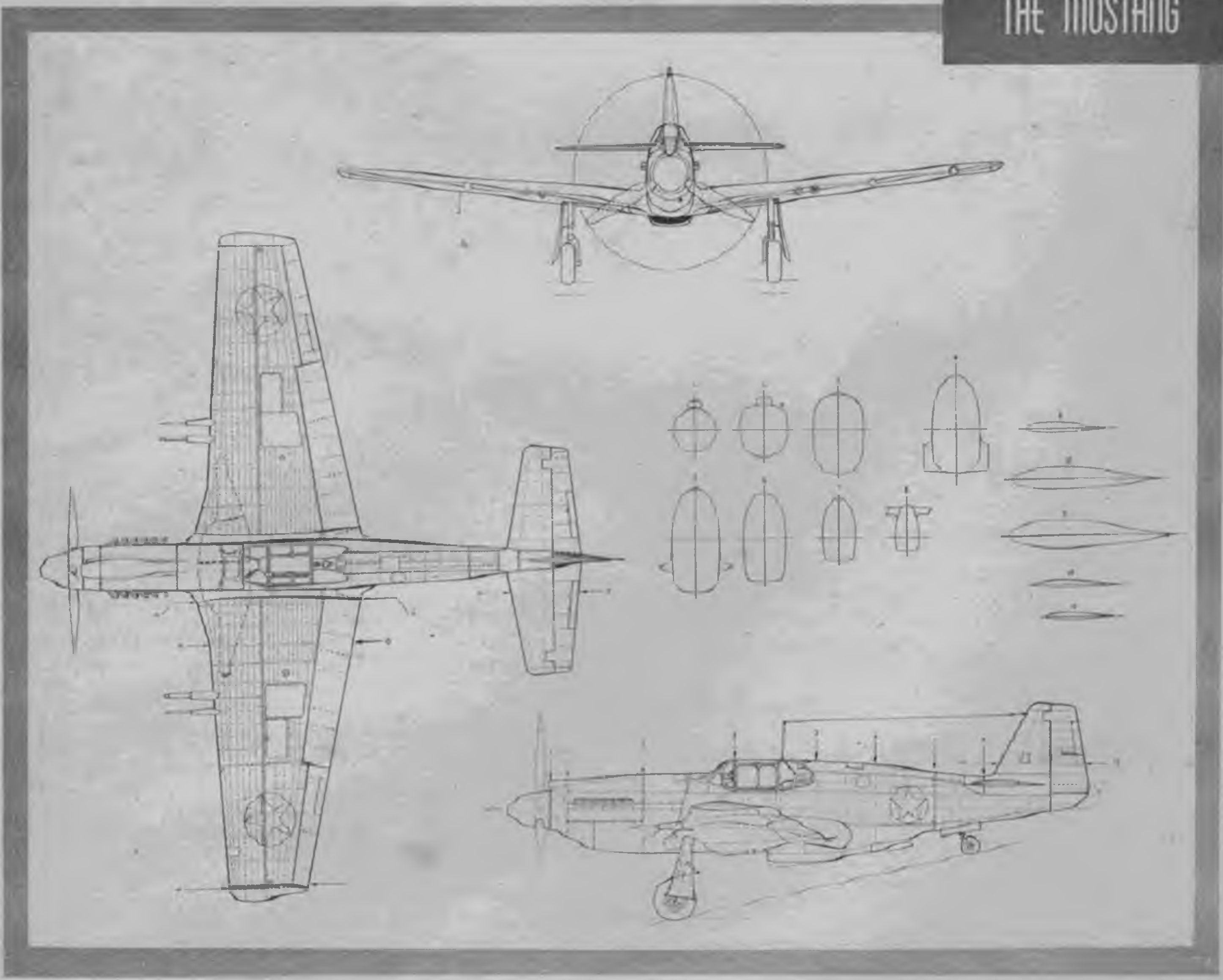


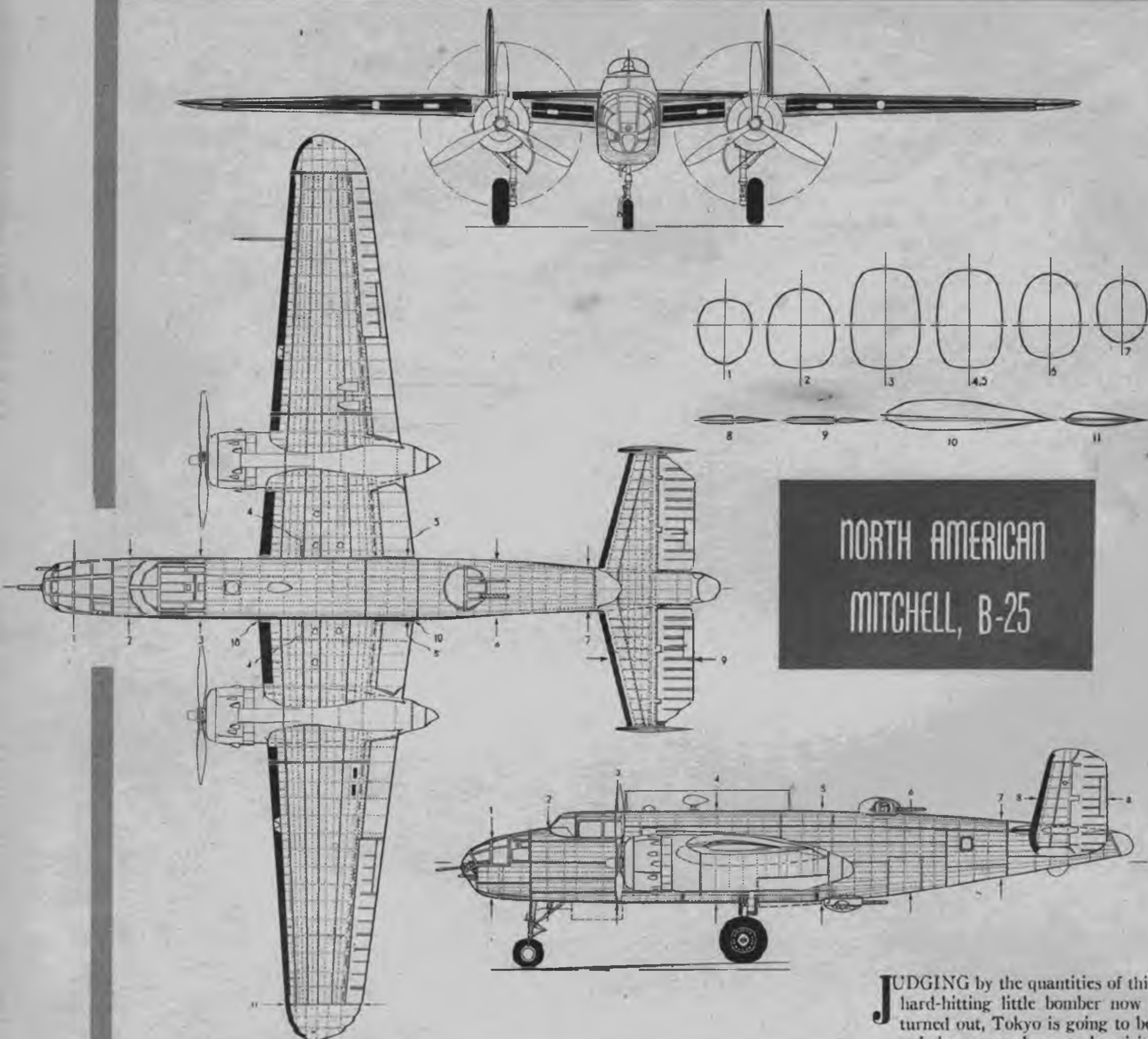
MITSUBISHI S-00

THE S-00, the famed Zero, is noted for amazing maneuverability and rate-of-climb characteristics resulting from extremely light construction and ample wing area. This performance was achieved at a sacrifice in safety features, such as leakproof tanks and armor. The heavier American fighters, with their devastating six .50-caliber guns, outspeed and outdive the Zero. By slashing in and out of a fight, our fighters have maintained fantastic scores over the nimble Zero. Another noteworthy feature is the lightweight auxiliary belly tank which boosts the range to 1,600 miles. This trick was developed by the Japs as long ago as 1937. Power plant, 1,200-h. p. Mitsubishi Kinsei; top, 345 m. p. h.; weight, 5,140 lbs.; armament, two 20-mm. cannon and two 7.7-mm. machine guns. A 500-lb. bomb may be carried instead of tank.

DESIGNED originally as a low-altitude fighter for the British, the North American Mustang, or P-51, is also one of our crack fighters. Originally powered by an Allison engine, the newer models have the Packard-built Rolls-Royce Merlin, which has a considerably higher service ceiling than the old Allison, due to two-stage supercharging. This new ship, the P-51B, has four 20-mm. cannon and a four-bladed propeller. The A-36 dive-bomber version was the last of the Allison-powered machines. Dive brakes were added. During the Sicilian campaign the Mustang dive bomber became known as the Invader. The extreme speed of the fine fighter results from the use of the laminar-flow wing, the first plane in the world to have one. With the R. A. F., the Mustang has replaced the Lysander as an army cooperation ship. Here it performs as a scout, attacking and observing at ground level in the vanguard of the invasion.

THE MUSTANG

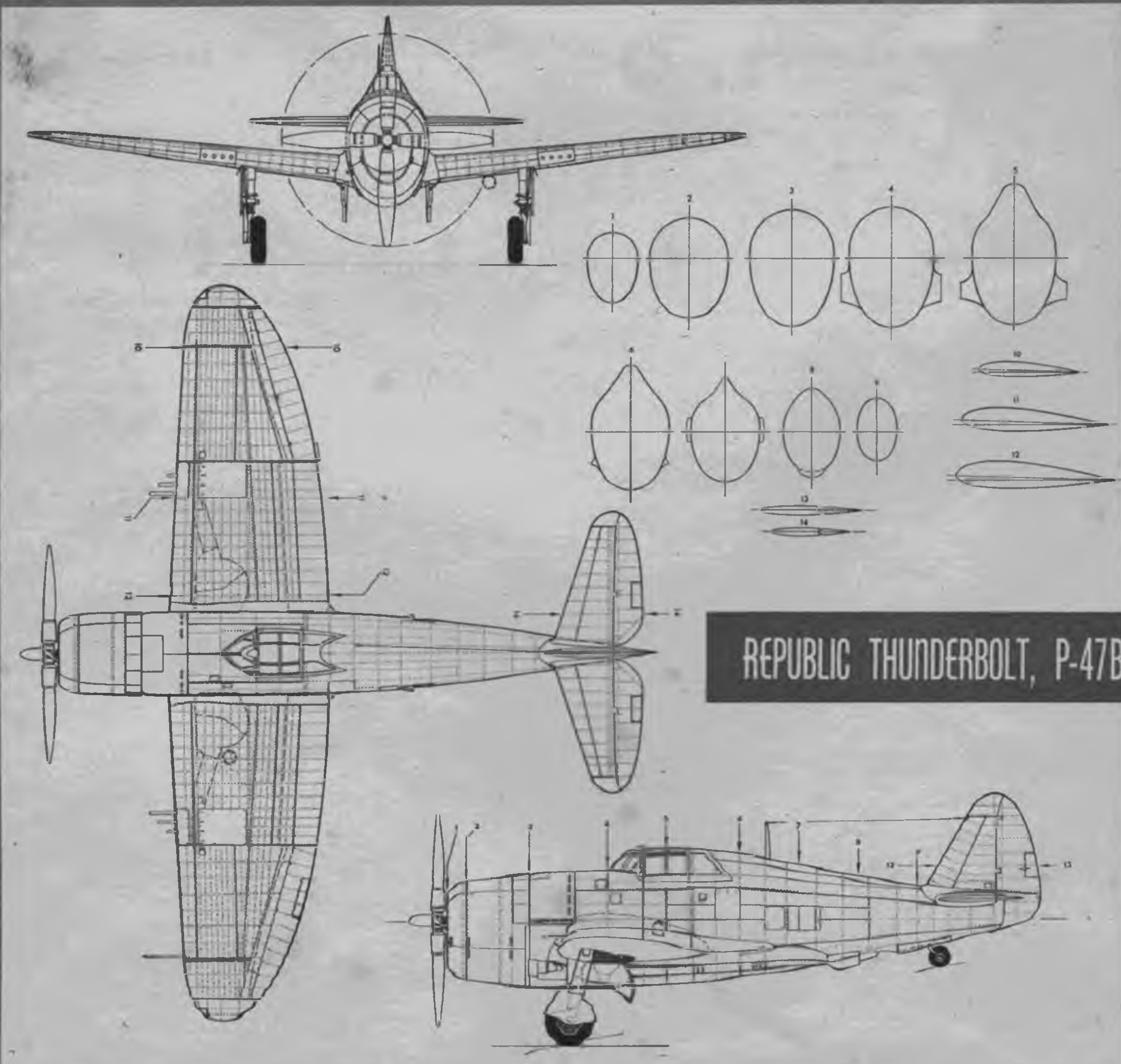




NORTH AMERICAN MITCHELL, B-25

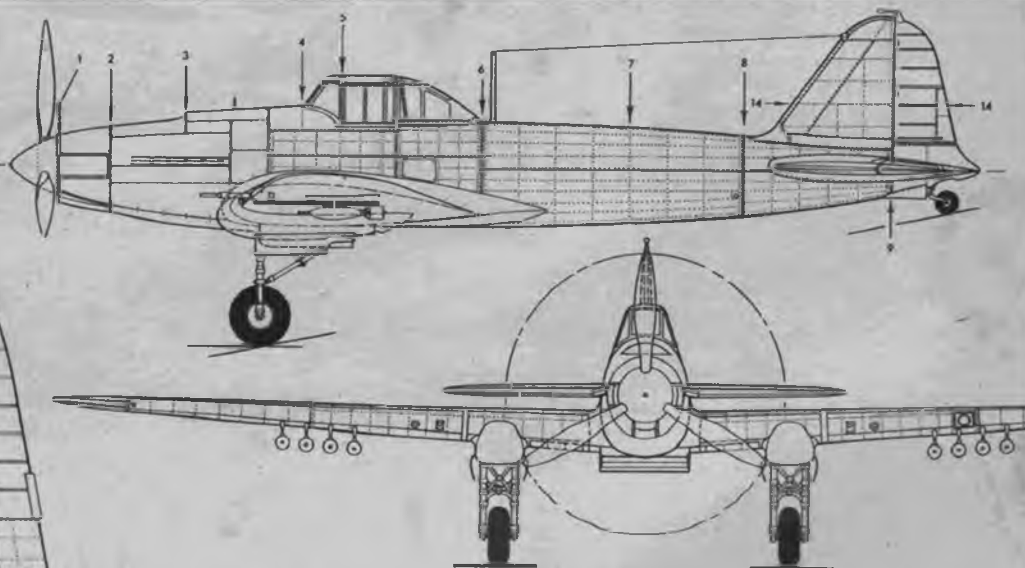
JUDGING by the quantities of this fast, hard-hitting little bomber now being turned out, Tokyo is going to be only one of the many places to be visited by the B-25. Ships like the Mitchell usually take time to design and develop, but North American applied real blitz tactics to its production. Before the Mitchell was even started, no less than eighty-five designs using the same specifications were conceived. The B-25 is in the same class as the Martin Marauder, but not so good-looking, though its straight lines are more adaptable to production. B-25s are going all over the world, and the first German submarine destroyed by the Army Air Forces was bombed by a Mitchell. Span, 67 ft. 7 in.; length, 54 ft. 1 in.; speed, over 300 m. p. h. Armament is restricted, but there are flexible nose guns firing through sockets in transparent panels: a two-gun power turret atop the fuselage; and a tail gun. Later models have belly guns, probably .50-caliber.

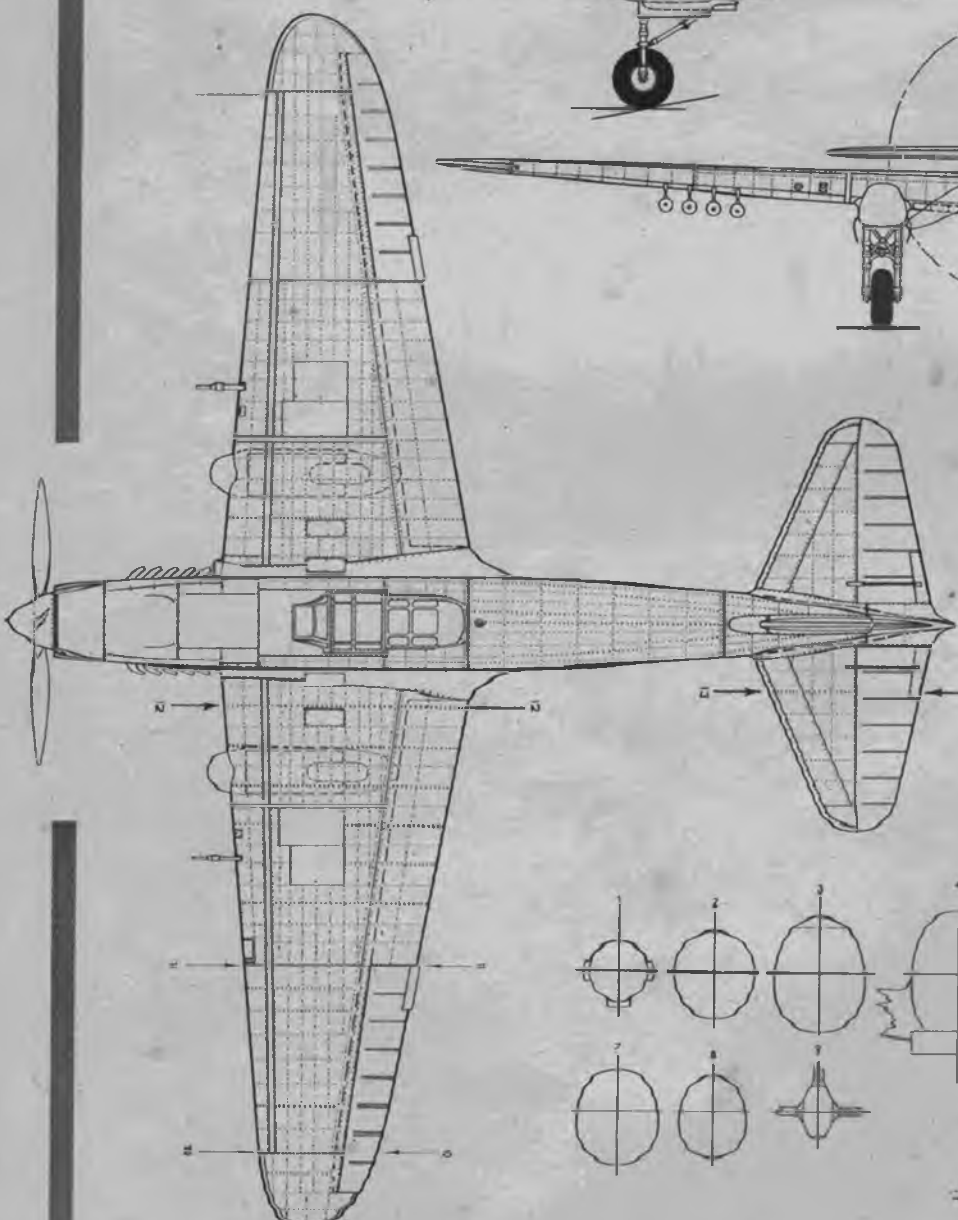
THE Thunderbolt, for its size, weighs more than a battleship! It is, without doubt, the most formidable offensive machine that man has devised to date. Meant for high-altitude fighting, it is turbosupercharged, has long range, and eight wing-mounted .50-caliber guns with a generous load of ammunition. All this results in a machine weighing more than the old Ford trimotor. Yet at its effective altitude, which is *very* high, it has a speed far in excess of 400 m. p. h. Nothing can touch it. No wonder, then, that it has shot down three Focke-Wulfs for every Thunderbolt lost. Auxiliary fuel tanks fitted under the wings enable the P-47 to fly the ocean, and to escort the day-raiding Forts deep into Germany.



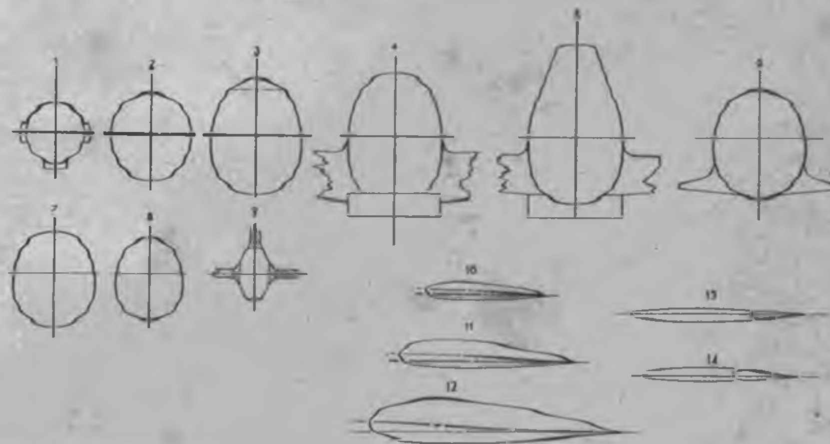
REPUBLIC THUNDERBOLT, P-47B

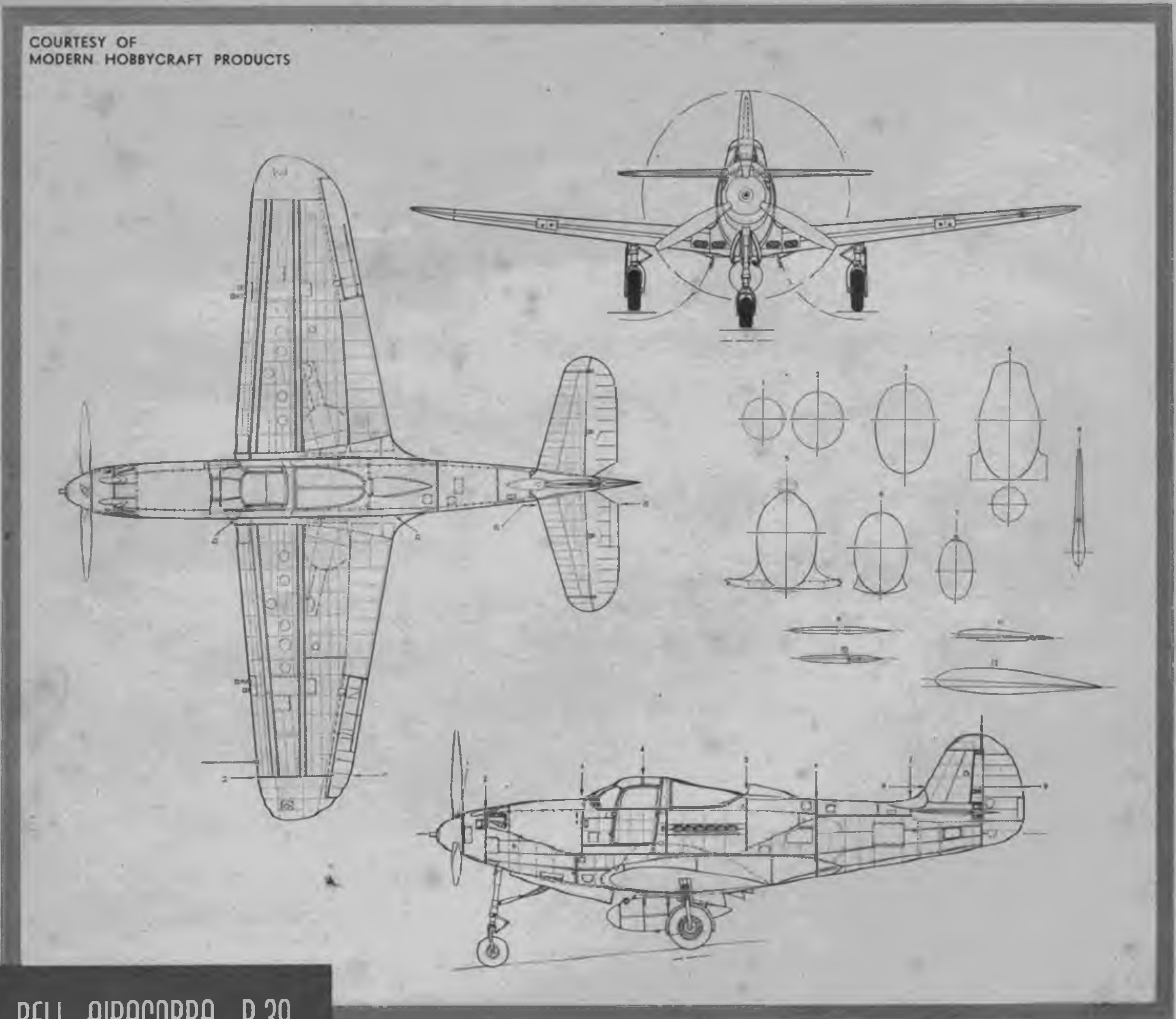
STORMOVIK IL-2C





THIS heavily armed and armored fighter-bomber was the first airplane to stop the German Panzers. Its high-velocity rocket bombs—the first of the war—penetrated the German tanks. Armament included two cannon of approximately 30 mm. One novel point was the fact that this was one of the first single-place bombers. Now, however, a rear flexible gun has been added. The heavy armor, essential on an aircraft designed for low-flying attack, protects motor as well as crew. The Stormovik, or IL-2, was designed by Serge Ilyushin. The power plant is a 1,300-h. p. liquid-cooled A. M. 38.

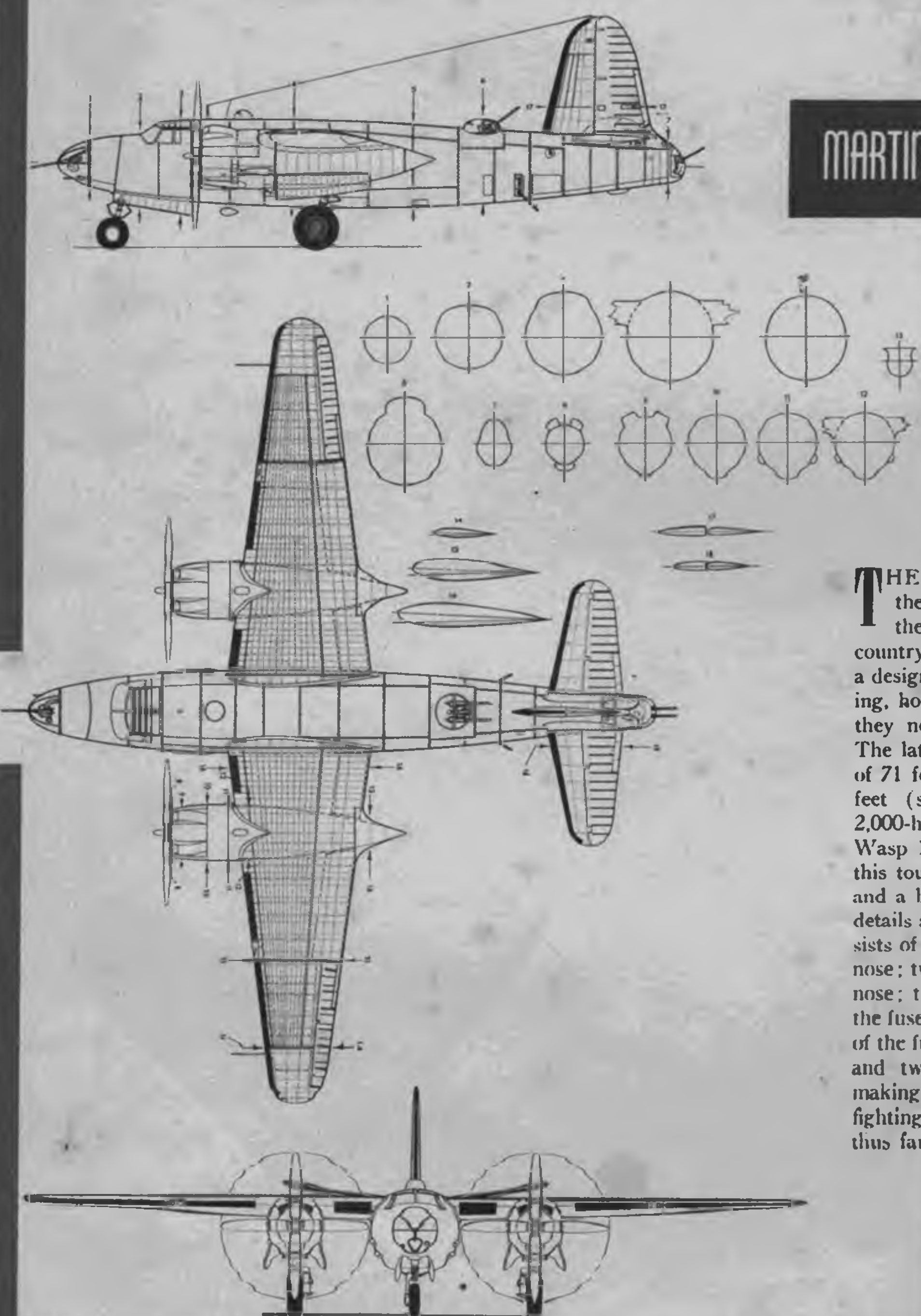




BELL AIRACOBRA, P-39

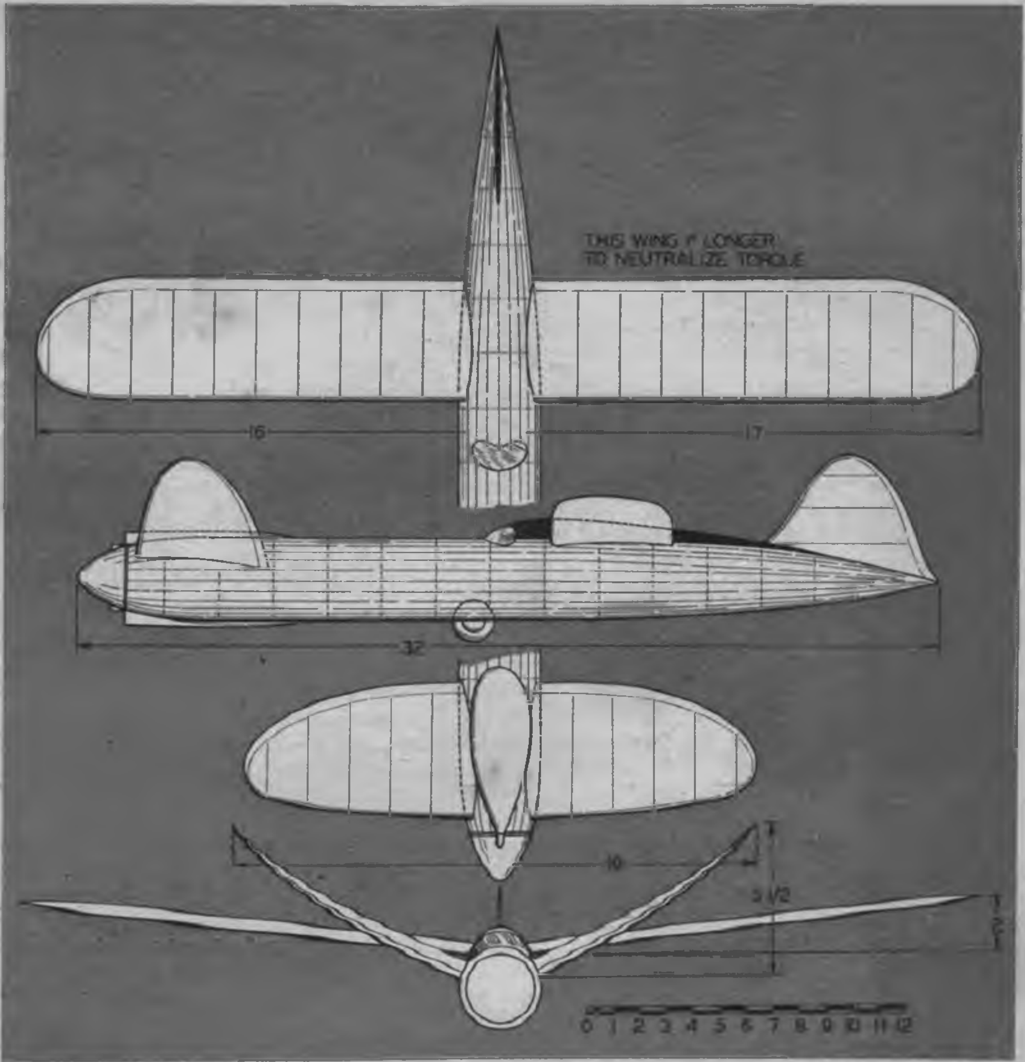
THIS low- and medium-altitude fighter was designed for tremendous fire power, making it a scourge of tanks and light shipping. In the Aleutians and the southwest Pacific the Bell has silenced antiaircraft emplacements by strafing, thus reducing resistance against accompanying bombers. The Airacobra has a fine record in all theaters save England, where the A. A. F. uses the high-altitude Thunderbolt. In Russia, where many Bells were delivered, the Airacobra is a darling of the fighter pilots, who make excellent use of its fine maneuverability and powerful armament. The Allison engine is behind the pilot, an extension shaft driving the prop. A 37-mm. cannon fires through the hollow prop shaft. Armament includes two synchronized .50-caliber and four wing-mounted .30-caliber guns.

MARTIN MARAUDER, B-26D



THE Martin Marauder is very probably the most powerful, the fastest, and the scrappiest medium bomber in this country. Aerodynamically, it's perfect—a designer's dream—combining streamlining, horsepower, and small wing area as they never before have been combined. The latest model, the B-26d, has a span of 71 feet (formerly 65 feet); length, 57 feet (shorter than before). The two 2,000-h. p. Pratt & Whitney Double Wasp 18-cylinder twin-row engines give this tough baby a speed of 285 m. p. h., and a bomb load of 2,460 pounds; other details are restricted. The armament consists of one .50- and one .30-caliber in the nose; two fixed .50s on either side of the nose; two .50s in the power turret atop the fuselage; one .50-caliber on either side of the fuselage just ahead of the stabilizer, and two .50-caliber in the tail turret, making the B-26d one of the toughest fighting machines to come out of the war thus far.

This sleek Canard is certainly aerodynamically superior to the crude jobs of the '30s. Prop in front improves performance, eliminates landing gear.



PROP FIRST CANARD

By Earl Cayton

THE Prop First Canard was built to be "something different with a pleasing appearance," and to prove that "prop first" models are practical. Almost any model builder who built and flew twin pushers in the earlier stages of model aviation will testify that they are the most stable and easy models to fly. Then, why has the pusher become practically extinct in present-day model circles? The answer is simple. Most modelers forget two basic facts. Those are, when you turn the wing and elevator around, the center of gravity should be moved forward, and the elevator should stall before the wing, which is the exact reverse of the procedure used on tractor models. Tests on tractors proved that the closer the center of gravity can be moved to the stabilizer without stalling the model, the more stable the model becomes and the better glide it will have. This condition is even more important in pushers. Designers did not have to worry about placing the C. G. forward on the twin pushers, due to the large amount of rubber concentrated in the front.

A few model builders have realized these facts and have built successful gas pushers, but very few builders of rubber-powered models have gone beyond the sporting stage in their experiments, due to the fact that they invariably mounted the propeller in the rear of the model, which necessitated the use of free wheelers and tricycle landing gears for the take-off, causing so much drag that they were practically eliminated from present-day contests.

With these thoughts in mind, the Prop First Canard was conceived. To put this pusher on a par with the present-day tractors, the prop was located at the front to permit the use of a folding propeller and a retractable single-wheeled landing gear.

A large part of the fuselage was extended far back of the wing so that the rudder would have a long enough moment arm to be effective, and to permit the use of a large motor.

On the field, the model showed remarkable stability and soaring quality. Even on windy days when tractor models had to be grounded, the Canard made flights of long duration. In a dead calm this model averages as high, or even higher, than most modern tractor contest models.

Underview of fuselage shows landing-light installation. This is operated from contacting switch attached to engine timer.

WE FLY BY NIGHT

By Dr. H. B. Newlin and Paul Enstad

IS YOUR USUAL FLYING FIELD UNAVAILABLE DAYS? TRY NIGHT FLYING CONTROLINE MODELS—HERE'S THE DOPE!

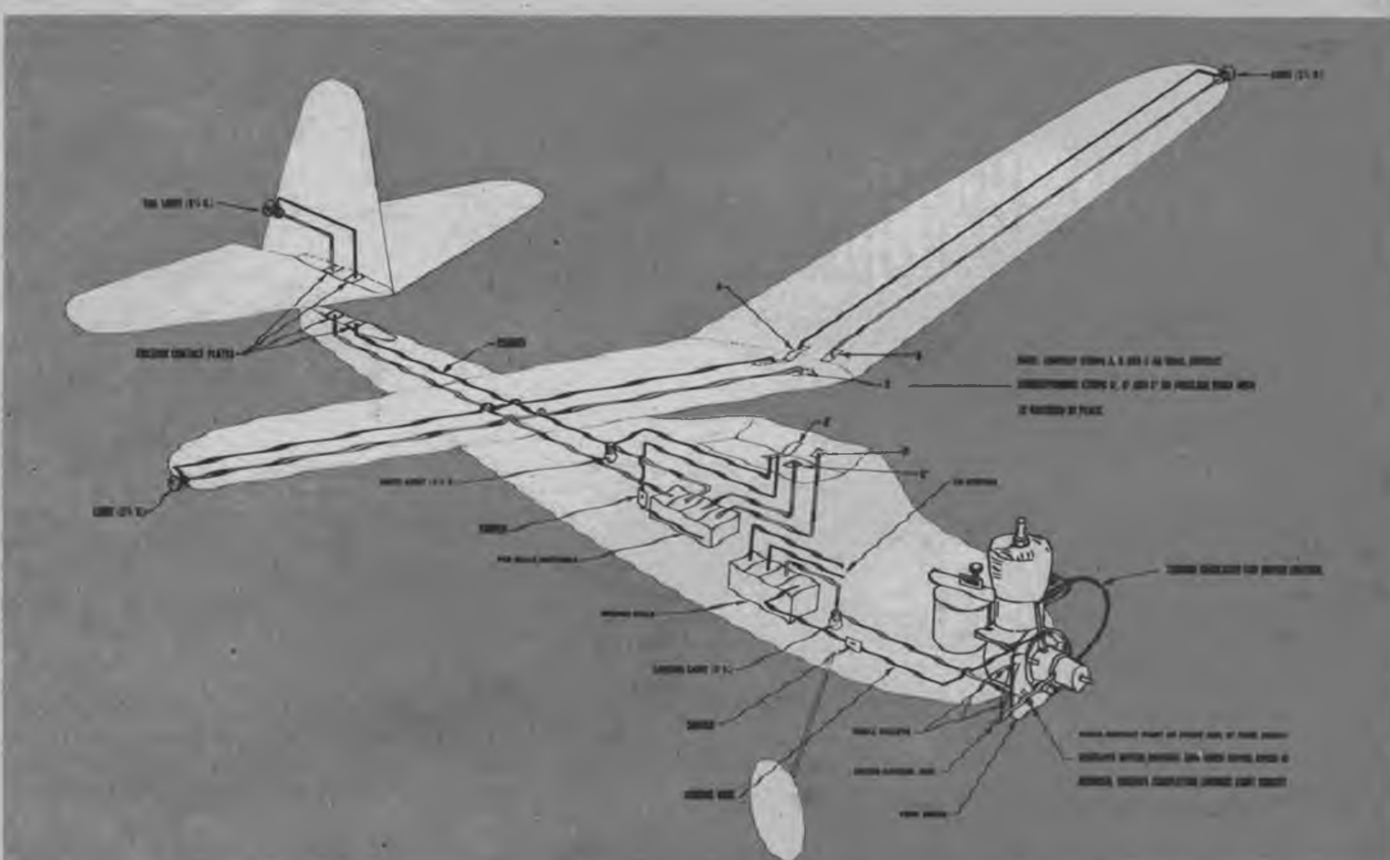
WHEN we were converted to controlled flight, someone had the bright idea of putting lights on the ships. One of our members hung lights over his Scientific Flagship; it was so successful that he made the navigating and landing lights more permanent by building in the lights and taping down the wires. This prompted another member to install lights on his Modelcraft Spook 72 which had been gathering dust.

The battery arrangements on the two ships differ. The Flagship batteries are fixed on the center of gravity; those of the Spook are arranged on a vertical sliding plywood panel in the belly of the fuselage. The latter arrangement corrects the balance when necessary. Both ships carry eight batteries: four pencells for navigating lights of one and a half volts; and four medium cells, two for a three-volt landing light and two for a three-volt ignition. Small-gauge enameled wire was used for solid wiring and cotton-covered radio antenna wire for movable wiring. The wings of both ships are wired for contacts so that the ships can be dismantled without having to disconnect the wiring. The navigating lights stay on all the time, but the landing light is subject to an automatic switch on the motor arm; both lights are controlled by off-on switches.

One idea for these two six-foot jobs was a reverse motor control: if a flying cable or control line should break in flight, the reverse control slows the motor and your outfit has a chance to recover. Another advantage is that no one has to hold your model while you run out to the handle.

An average night's flying will cost about fifty cents' worth of batteries. Medium cells used one night for ignition are transferred to the landing-light battery box the next night. New pencells are good for about twenty minutes of flying if time is broken into two ten-minute periods. Medium cells work for forty to fifty minutes of flying.

We have put some trick gadgets on the two ships that have been a lot of fun and have won considerable applause from the crowd. The Spook has a parachute release activated by an Austin timer. The Flagship has a smoke-screen device, bomb release, and parachute—all operated by one Austin timer. We've put on everything but the kitchen sink—and that's next!



Gliders

IN this ration-stamp existence, gliders are coming more and more into favor. Where several seasons ago gliders were ignored at contests, now officials are scheduling one or two events for them, and whole meets have been devoted to such craft during the past year.

Fundamentally, gliders are simple to construct and do not require a great deal of cash outlay. Their adjustments, although somewhat critical, are fundamentals of model behavior; beginners and experts alike can learn much from such craft.

During the past year, no great advances have been made in either design or construction of gliders, but the coming season should show great strides in the field. Launching, especially of towline gliders, has always been more or less critical, but several devices to nullify the diving tendencies of gliders have entered the picture. Henry Struck first designed such a gadget several seasons ago and included it on a ship entered in New York contests. His "Sinbad" was so fitted and won many first places. The device, a simple mechanism to hold the rudder at a certain setting during the launch, then adjust it for flight when the line had dropped, was made to fall away with the towline. For many seasons this gadget was ruled illegal under AMA rules, but it is understood that 1943 rules will permit its use.

Hand-launched gliders have not improved a great deal through the years. A design originated in 1937 by Joe Hervat is still standard in the New York area, while Al Casano's Jersey type is continuing to win contests in that section. Howie Beitchman, who still holds the Class B HL record (he's with NACA now) once flew a Class B glider with a 2-1 aspect and lost it on his first flight. The HL class of glider could stand considerable experiment, but one fundamental—that of smooth finish—remains necessary for good ships.

An interesting innovation within the past twelve months has been the conversion of many rubber- and gas-powered contest jobs into towline gliders. Of course the changes necessary require considerable tinkering, but no modeler minds that. At the same time it provides a use for old gas jobs that have outworn either their usefulness or their motor.

Last autumn on the West coast, a large gas model club scheduled a towline meet. Members were busy building for several weeks and finally the meet was held. Of course, a fine design won the meet, but several interesting change-over ships placed high. Don Foote (who authored the Westerner) made over a four-foot gas model by removing motor, coil, battery box, landing gear, et cetera, and adding a long boom to the motor mounts. This boom projected nearly a foot in front of the ship, and at the extreme end Don had mounted an Austin timer to trip a dethermalizer. It was a weird-looking contraption, but it flew well enough to encourage future experiments.

Recently in a Long Island meet a Comet Sailplane redesigned for the towline class took a high place. A Buzzard Bombshell, redesigned, also did well. Ships with longer nose moment arms are usually easier to redesign than pylon jobs.

Along the same subject, ships with thick airfoils are usually more efficient as towlines than those with the thin airfoils used on some gas jobs. West coast builders, who have always favored thick foils, advocate the RAF 32 for all ships and claim said foil is even better with the trailing edge depressed ten degrees.

One difficulty with towlines—up to the present, at least—has been the extreme weakness of wings when high aspect ratios were used. A seven-foot wing with a narrow chord is very beautiful, but the weakest gust of wind is quite able to snap a spar. For that reason gliders are changing design somewhat to accommodate heavier spars. Thicker wing sections, at the root, tapering toward the tip, seem to be one answer. Lower aspect ratios may come as a result of this weakness. In fact, the way that remodeled gas jobs (with low aspect ratios—below 6-1) fly indicates that little would be lost but beauty.

During the past twelve months, few radical designs have come from the modelers, although one item which has recently been introduced has become almost a must in the class. Because towlines have a light wing loading (usually around four ounces per square foot in larger designs) they are exceedingly thermal-conscious. At the merest breath of a thermal they head out for the hills, and with gas (and autos) being rationed they are hard to recover. Hence that little gadget—the dethermalizer—has become almost a necessity. Various means of operation have been devised, but in such ships the depressed (or shifted) rudder is usually sufficient. At the lapse of a pre-established period of time the timer (usually compressed air) trips a latch which allows the elevator to assume a steep positive or negative angle. The plane mushes in, and because of the low wing loading, little damage is done. Some modelers prefer the parachute type of dethermalizer, but in either case the result is the same—the ship loses the thermal and is recovered with a minimum of worry and effort.

So far, towline gliders have not departed much from the established manner of construction. Substitute materials have generally been heavier and more difficult to use—and almost as hard to obtain. However, many commercial manufacturers have introduced processed cardboard for formers, ribs, et cetera, and their ships have not suffered too much.

It is easy to predict that during the next twelve months gliders of all types will come to the fore. We can expect more glider contests and consequently advancement in designs generally. Possibly a means will be devised for folding towline wings until they no longer present a hazard to the builder and innocent bystander while being carried to and from the field. Radio-control gliders will have to wait until after the war, but during 1943 some experimenters did research on gliders controlled by strings from the ground, and possibly this field will open up during 1944.

We can expect glider design to be influenced by the many types of invasion gliders being manufactured in this country today. These designs should prove sturdy and quite simple to construct, and if they fly like their replicas they should prove very popular in the field.

In 1941, many glider enthusiasts were requesting that AMA schedule a glider event for the Nationals of that year. This move was not approved due to the general lack of enthusiasm throughout the country. However, now that war-time restrictions have brought the glider into such prominence we believe that henceforth all National meets will schedule glider events, and these events will prove to be the most interesting at the competition.

Gliders still offer one of the best media for the novice to enter the hobby. From them he can learn many tricks of building, flying and designing that will help him immensely; and for expert builders who are bored with the whole thing—we advise them to turn to gliders. They'll find new thrills in the old game—thrills they never before knew existed.

SUPER SOARER

SO YOU CAN'T GET ENGINES, CHUM! TRY GLIDERS. THIS 14-FOOTER IS SOMETHING TO SHOOT FOR, NOT AT.

WITH rubber and gas engines becoming increasingly difficult to obtain, it seems that a large number of model builders are getting interested in towline gliders. I thought, therefore, that they might like to hear about some of my experiences in building and flying a fourteen-foot sailplane and hope that it will help stimulate activity in gliders, which actually are far more fun than powered models. In fact, I'll bet that once you've had the thrill of watching your glider float silently into the clouds, you won't regret not being able to fly gas jobs.

Before building this job I built a seven-foot ship. This model flew fairly well, with the longest flight lasting fifteen minutes. It finally came to an end befitting any good model by flying out of sight in a general northeasterly direction one day, but not until I had been able to get about seventy-five test flights which gave me

Model comes apart in compact sections for traveling. Wings doweled to body

By Gordon Lambrecht

Dethermalizer foils out-of-sight tendencies.

Give a look! The builder's behind model.

Center-section close-up shows cleanness.

much data that was valuable later on the larger job. When winter came I settled down to work on the largest model soaring glider I have ever seen. Finally, after six months of work, she was ready for test flights.

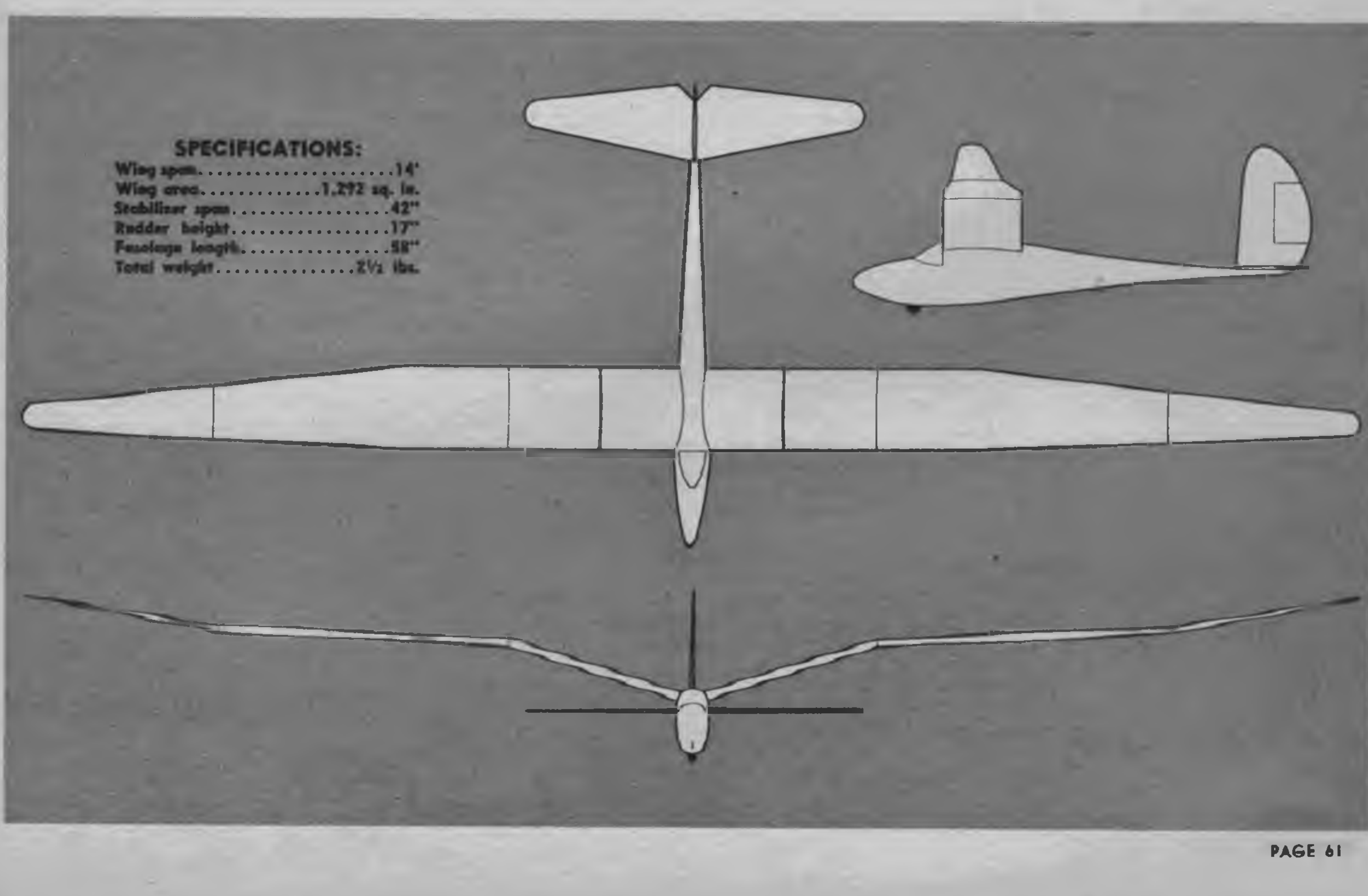
The longest flight I have ever had on it was thirty-eight minutes. We tow-launched the ship on a very hot summer's day, using a 100-foot line. When almost overhead, she released, immediately hit a powerful thermal, and went up like an elevator. In the ensuing twenty-mile chase we managed to keep it in sight for thirty-eight minutes, but the big job finally got up so high that it gradually became just a speck and finally disappeared. Three weeks later I got word from a farmer that the ship had landed in his back yard, some fifty miles from the original launching point. It was rain-soaked, but in good shape nevertheless.

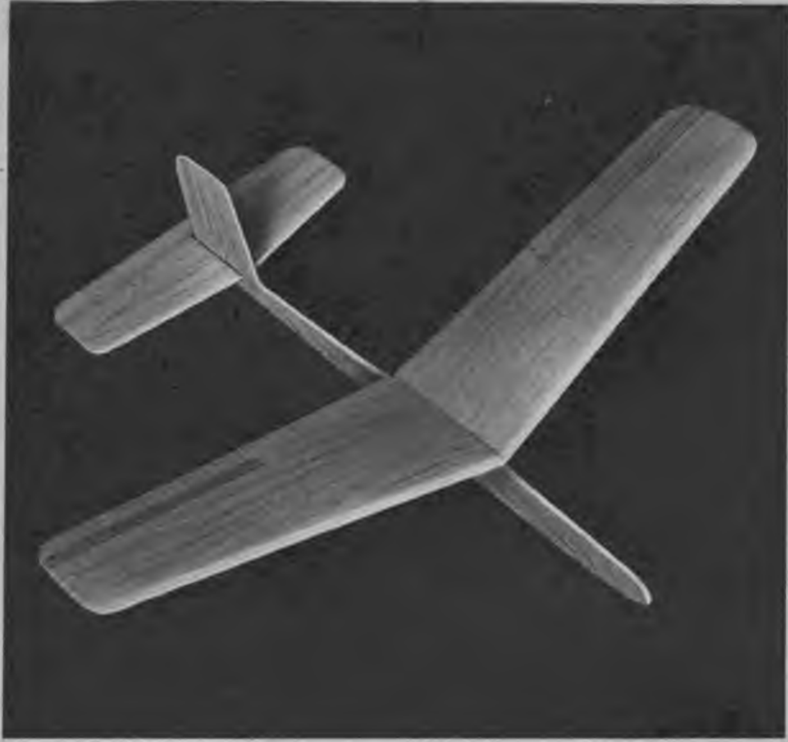
That flight was a good lesson as to the tremendous flying capacity of model sailplanes; but now, to keep the ship from ever making a repeat performance, I have equipped her with a simple dethermalizer designed by Carl Goldberg. At a predetermined time, controlled by a pneumatic timer, the stabilizer pops up to a negative angle of thirty degrees and the ship mushes swiftly to the ground in a horizontal position.

The body is built up in the conventional bulkhead-and-stringer manner, using very hard 3/16"-square stringers. The nose is made from five separate pieces of pine and is hollowed out to house a small camera. Cameras, incidentally, work far better on gliders than on powered models, due to the absence of vibration which tends to blur the picture.

The wing has a ten-inch chord at the root, and rapidly tapers down to three inches at the tip. Ample strength is provided by seven deep spars running the entire length of the wing. The ribs are set close together, and are patterned after a wing section developed by myself after much experimenting on various model gliders. The dihedral, or rather polyhedral, is of a special type used first on certain German sailplanes. It seems to work very well on models and provides a great amount of stability in tow-launching the model. For ease in transportation, I made the wing in three sections, the two outer sections being six feet long and the center section (which is permanently attached to the body) two feet. Four 1/8" dowels, 11" long, are used to attach the outer section on each side. The dowels slide tightly into aluminum sleeves, the friction preventing the wings from ever coming off except in the case of a crash.

The launching cord has a ring on the release end, and about 18" from the ring a piece of cloth is attached to help pull the line off the ship by its increased drag. A fishing reel works very well in winding up the towline, being fast and convenient.





AIR YOUTH GLIDER NO. 1

By W. F. Tyler

THIS MODEL, FEATURING HARDWOOD CONSTRUCTION AND MOVABLE CONTROL SURFACES, HAS BEEN DESIGNED ESPECIALLY FOR GROUP CONSTRUCTION IN SCHOOLS.

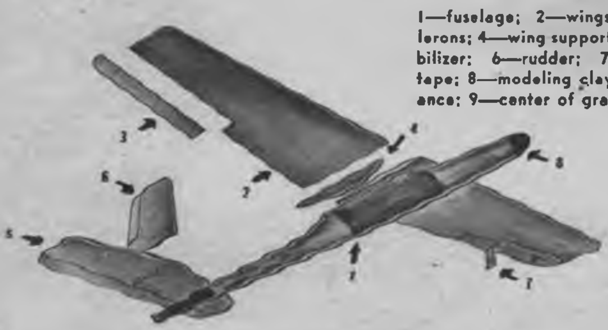
AIR TRAILS offers this simple, hand-launched glider as the first of a series designed for classroom construction. It incorporates all the qualities required for a successful flying model, yet its construction is simple enough for a novice. It differs from the usual hand-launched model in that hinged control surfaces have been added so that, by experimenting with different control settings, the student "learns by doing." The model is built from sugar pine, but other hardwoods can be used; additional weight means increased flying speed, but the gliding angle remains about the same.

Enlarge the drawings to full size by using the graphic scale given. After the enlargements are made, make cardboard patterns of the various parts. Start the wing construction by tracing the wings (2) onto the wood (Fig. A); cut the extra wood down to the outline. Use a sandpaper block to finish the tips and remove irregularities (Fig. B). Hold the wing halves together while sanding to keep the outlines identical. The wings are tapered to $^1/_{16}$". Begin the shaping (Fig. C) by taking off thin shavings with a small block plane; check the contours after every few chips. Keep the trailing edge, rear edge of wing, as thin as possible. Finish to size with rough and finally fine sandpaper (Fig. D). Bevel the ends of the wings for the proper dihedral angle (Fig. E). Block up one wing tip to 3" and carefully sand the bevel until the angle matches the dihedral (Fig. 1). Wing supports are now made from $^1/_{16}$" sheet.

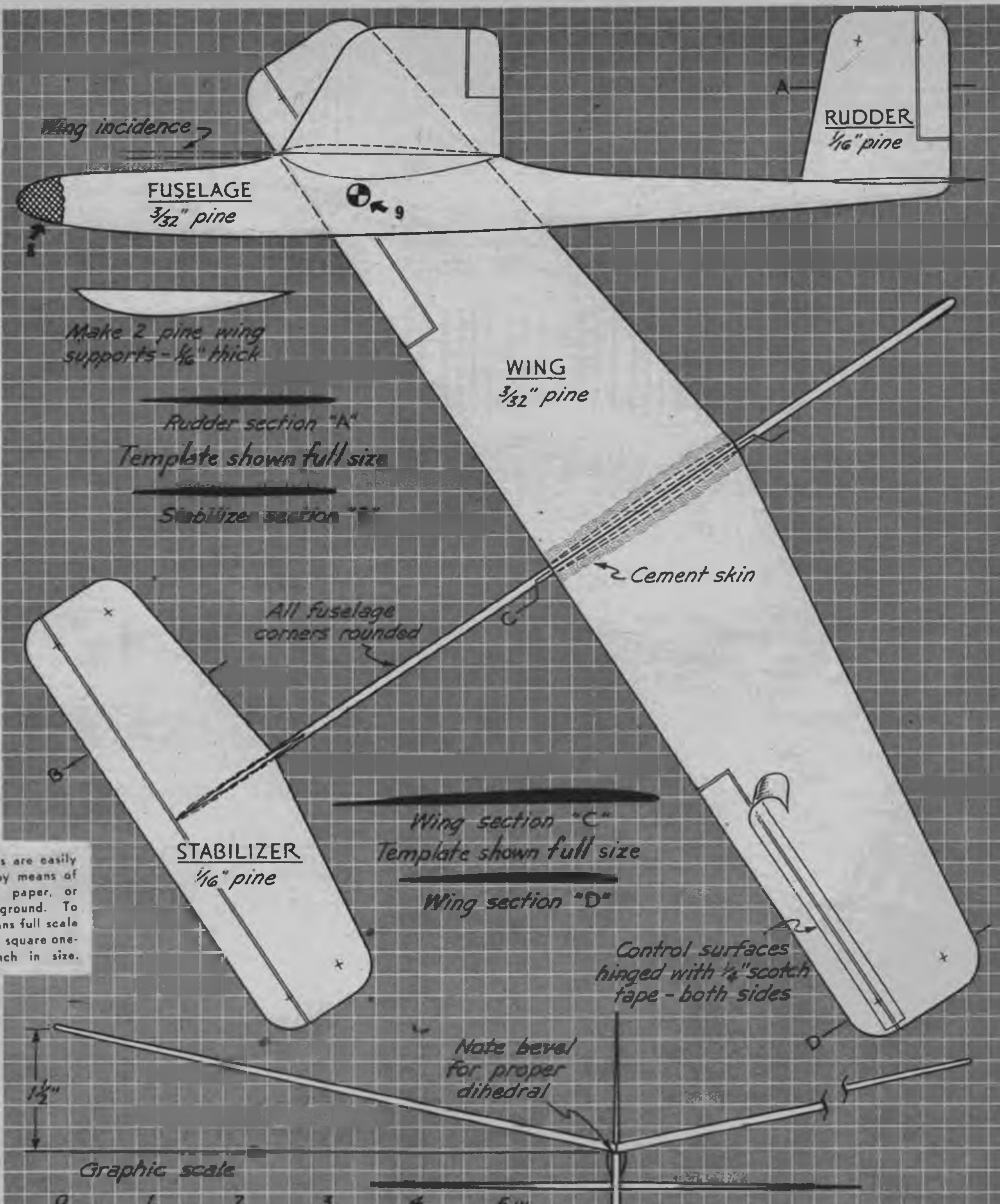
Make certain that the top slope of the fuselage is at the proper angle for wing (see Fig. G). Make the stabilizer (5) and rudder (6) by the same method as the wing; both have maximum thickness at center of $^1/_{16}$" and taper to $^1/_{32}$" at the tips.

Give all surfaces one coat of clear dope and a final sanding. Cut the control surfaces (Fig. F), and hinge with Scotch tape.

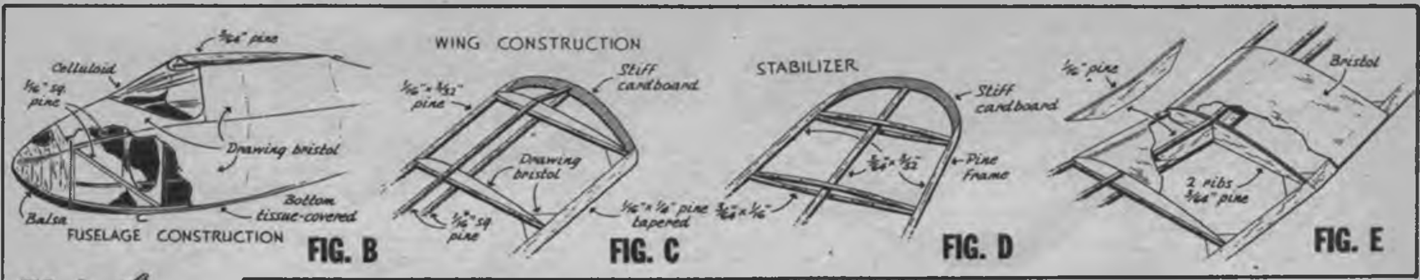
Check the model over carefully to make sure that everything is in line. For ordinary flying, all the controls should be set at zero. If your controls are extra flexible, a small piece of Scotch tape placed over the edge of the controls and the main surface will keep them in line. Add weight, preferably modeling clay or putty, to the nose until the model balances at 9 (side view of main plan). If the model tends to stall, add more weight until the plane glides in a straight line. Once the adjustment is correct, you can use more powerful launching by turning the rudder slightly to the left so that the model glides in counterclockwise circles. Then turn the right aileron down slightly to hold the circle adjustment.



1—fuselage; 2—wings; 3—ailerons; 4—wing support; 5—stabilizer; 6—rudder; 7—Scotch tape; 8—modeling clay for balance; 9—center of gravity.



These plans are easily enlarged by means of the graph paper, or grid, background. To redraw plans full scale make each square one-quarter inch in size.



AIR YOUTH GLIDER NO. 2

By W. F. Tyler

REALISM COMBINED WITH SIMPLE CONSTRUCTION—PLUS PERFORMANCE—MAKES THIS TOWLINE GLIDER AN INTERESTING SUBJECT.

THIS glider bears a close resemblance both in appearance and construction to actual full-size utility gliders. Two-ply Bristol board, stiff cardboard, assorted pine strips, a nose block of scrap pine or balsa, light model tissue, dope, cement and a paper clip for wire fittings are all the materials required.

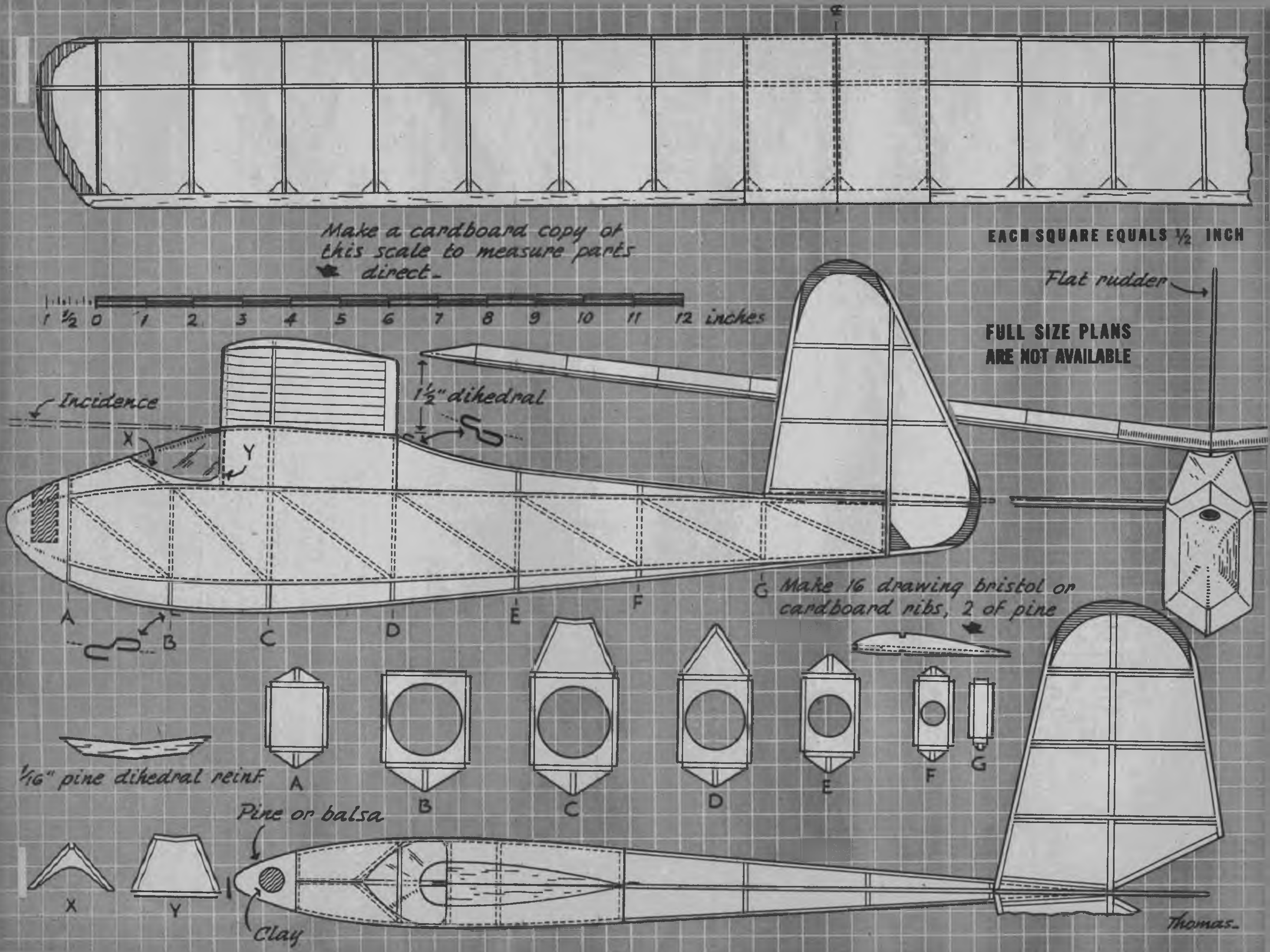
Make a duplicate of the graphic scale as shown on the plans and use it to measure parts in order to redraw them full size. You'll find the graph-paper background useful in duplicating wing tips, fuselage shape, et cetera. Begin by laying out the two fuselage sides on two-ply Bristol board. Draw in the formers and longerons. Cut out the two sides with a scissors or a razor blade, then cement in place the $^1/_{16}''$ square stringers and cross members. Cut the formers from Bristol board as shown in Figure A. Cement the two fuselage sides together at the rear, add formers. See Fig. B for nose and wing-mount construction.

Add the wing mount, which is angled to correspond with the dihedral of the wing. Cement in the top and bottom stringers and add Former X. Shape the nose block from scrap balsa, or pine, and add Former A. Cut the hole in top of nose block. Cut the cockpit cover from celluloid or cellophane and glue in position. Cover the area from Former A to D on top of the fuselage with a fairly heavy grade of bond paper; fashion the simple wire fitting from a paper clip; cement in place.

The wing and tail are conventional except that stiff cardboard has been substituted for the usual tips and the wing ribs are Bristol board. This Bristol board is used for all but the two end ribs and is reinforced by a strip of $^1/_{16}''$ square pine glued along the side; see Fig. C. Build the wings in two separate panels, then join together as shown by Sketch E. Use plenty of cement and block up one wing tip until cement dries. The stabilizer ribs (Fig. D) are cemented in pairs, passing over and under the stabilizer spar. The rudder is flat. Either $^3/_{64}$ x $^3/_{32}''$ or $^1/_{16}$ x $1/8''$ pine strips may be used for the outlines.

Cover all parts with ordinary Silkspan and spray lightly with water. When dry, apply a coat of thin dope. Cement the tail in place—first the stabilizer, then the rudder. The wing is held in place by a rubber band.

Try several test glides for balance. You'll probably have to add weight to the nose until the center of gravity is one third the distance back from the leading edge. By warping the rudder slightly, the model will circle, but don't overdo or towline flight will be difficult. Use seventy-five feet of strong thread, looped at one end. Have a helper hold the model while you walk out with the towline. He releases the model and you run backward, slowly towing the ship into the air against the wind. When it is overhead, slack off the towline, which automatically drops off the hook.



Make a cardboard copy of this scale to measure parts direct.
1 ½ 0 1 2 3 4 5 6 7 8 9 10 11 12 inches
EACH SQUARE EQUALS ½ INCH
Flat rudder
FULL SIZE PLANS ARE NOT AVAILABLE
Incidence
X
Y
1½" dihedral
A
B
C
D
E
F
G
Make 16 drawing bristol or cardboard ribs, 2 of pine
1/16" pine dihedral reinf.
Pine or balsa
Clay
Thomas.

SOUTHERN BELLE

By Ed Wimmer

TRY THIS SLEEK TOWLINE GLIDER FOR A SURE-FIRE CONTEST WINNER. RUGGED CONSTRUCTION, CLEAN LINES MAKE HER A "THERMAL GITTER."

High wing loading and flat bottom airfoil give this model a fast gliding speed needed to hop from thermal to thermal for increased duration.

DUE to the increasing shortage of rubber and of gas motors many model builders have turned their talents to the construction of the long-neglected sailplane; and so has the author—with amazing results. His attempts have been quite justified, as you can see by glancing at the photographs and plans that accompany this article.

If you are looking for a really "solid" towliner, then you need look no further. The model also fits all A. M. A. contest requirements.

Construction: Construction is begun by enlarging the plans to full size; this can be done easily with a little time and patience. Use a sharp-pointed pencil to insure accuracy.

The fuselage is built first. The floorboard is cut from 1/8" sheet balsa and is the main part of the body. The formers are cemented to the floor at right angles and then notched when dry. The keel outlines are cemented into the notches. The section over the wing is made removable for ease in transportation. The fuselage is now ready to be planked with very soft 1/8" strips. When this has been done, cement the noseblock in place; the latter is made of fairly hard balsa, as it takes the shock when landing. When dry, sand entire fuselage until the planking is about 1/16" thick. Then smooth down with very fine sandpaper. A nice finish can be obtained by applying several coats of wood filler with sandings between coats.

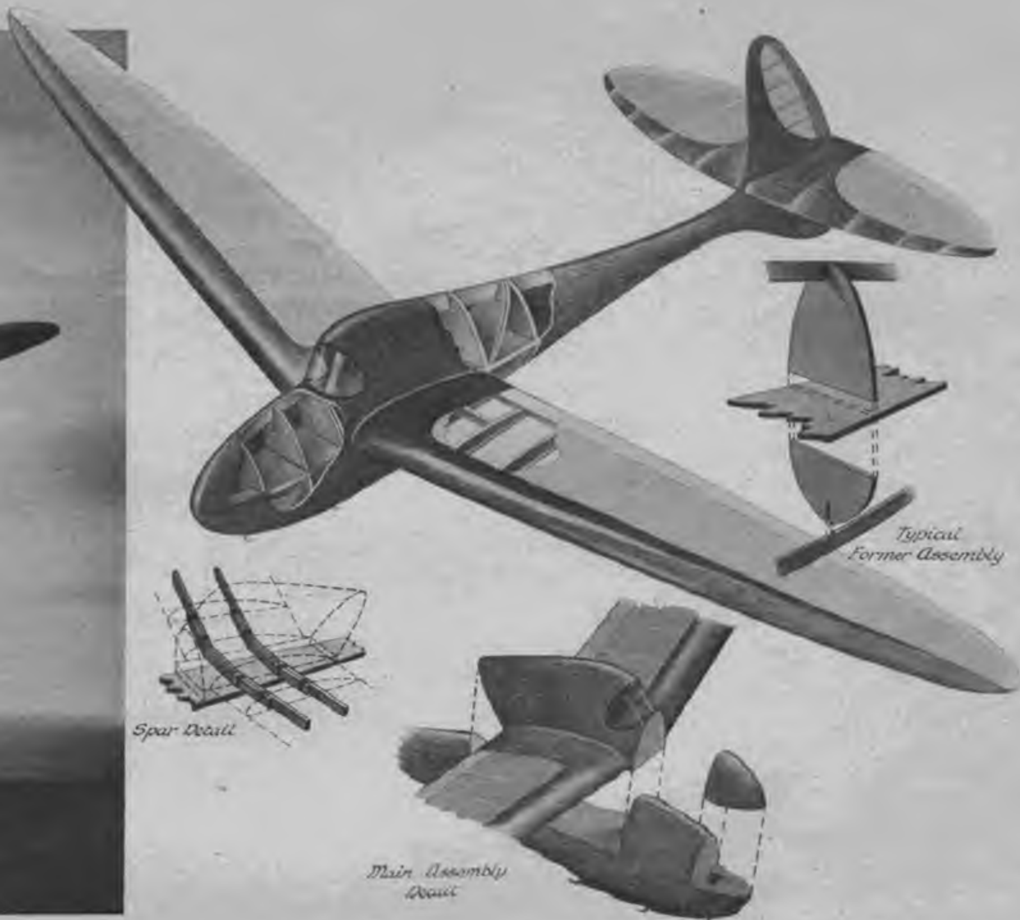
The wing can be made next so that it can be fitted against the body's removable section. The trailing edge is made from 1/8" sheet and is pinned to the workboard. The wing ribs are cut from 1/16" sheet except the center rib which is medium hard 1/8". The brace spars are hard 1/8" by 1/2" and only extend so far as is shown on the drawing. The 1/16" sheet planking can now be cemented in place. Do not omit this for the strength of the wing lies here. Use several coats of cement where the ribs meet the 1/4"-square leading edge. Notches are cut into the fuselage where the auxiliary spars pass through. Use plenty of glue at this station. The wing spars and the spars that pass through the body are cemented together at an angle that will allow a tip rise of 4 3/4". The joint is then bound with thread.

The tail can be easily made by following the instructions on the plans.

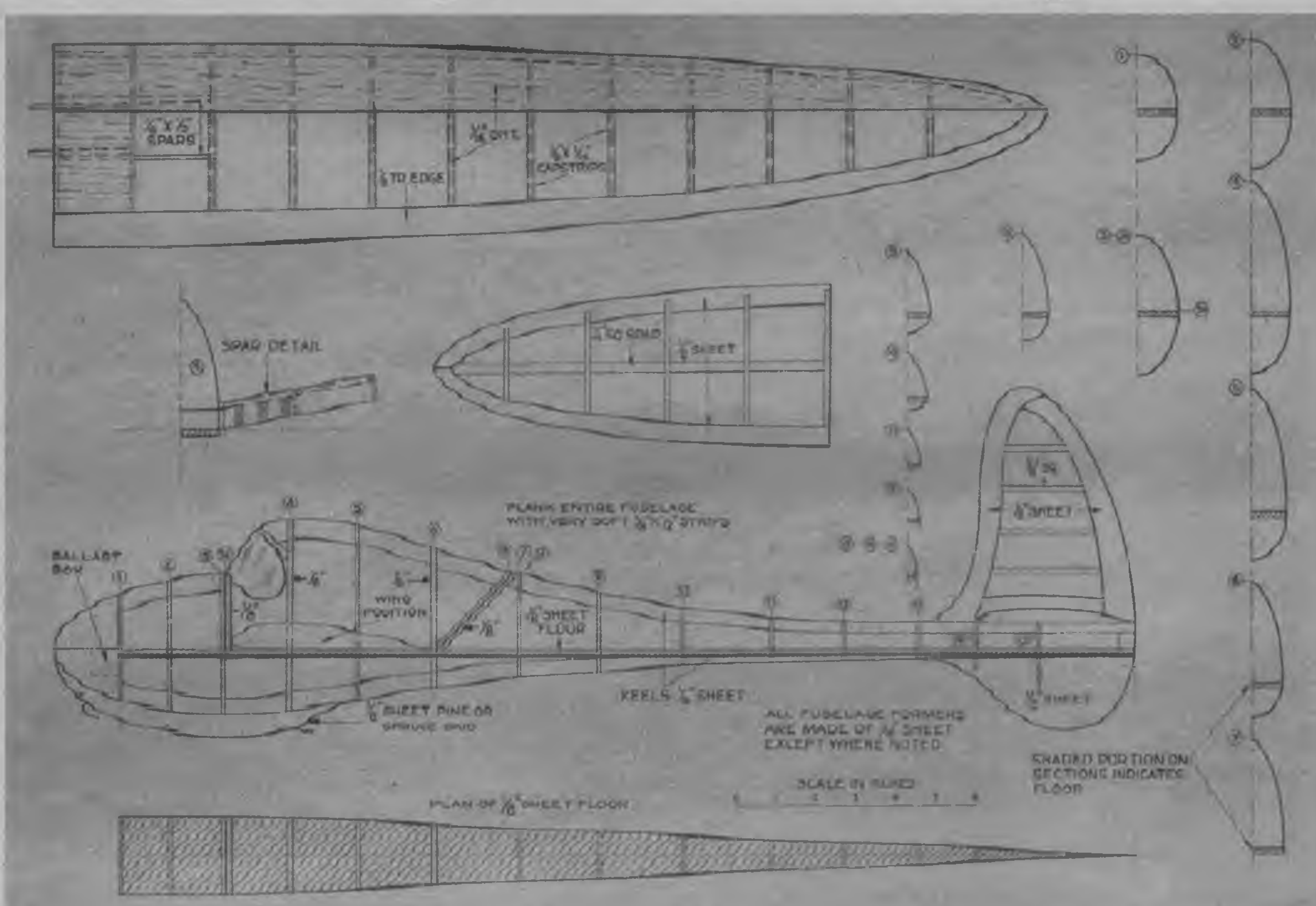
Cover the surfaces with a good grade of tissue, using fairly thick dope. The tissue should be of a color that can be seen easily from the air or on the ground; it should be applied with the grain running spanwise. Spray lightly with water and allow to dry. This will cause the fibers of the paper to compress and the covering will be taut. Use about three coats of clear dope on the surfaces with a slight sanding between coats. The fuselage should be doped in a color which contrasts with the wing and tail. The original was striped in a bright red with a yellow background.

The windshield can be added now as well as the landing skid, which is made of pine or very hard balsa. The tow hooks are cemented to the skid. The stabilizer is cemented to the fuselage and the rudder and sub-rudder are cemented in place.

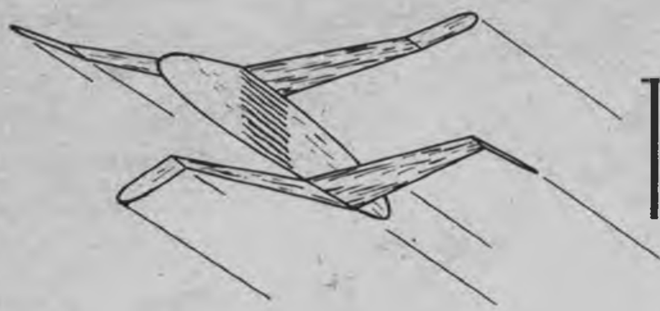
Flying: Adjust for a long, smooth glide. Do not adjust for a nose-high glide but for a nose-low flight, so that it will not "mush" in flight. Use No. 8 thread for the tow cord; ordinary kite string can also be used. A good launching technique can be had only with practice. The model should be towed into the wind and when it has reached its maximum altitude, walk slowly back toward the spot where you started and the tow cord will slip off the hook and the glider will begin its search for updrafts.



Typical Former Assembly
Spar Detail
Main Assembly Detail



SPARS
SPAR DETAIL
BALLAST BOX
WING POSITION
FLOOR
KEELS SHEET
SHEET PINE OR SPRUCE SKID
PLANK ENTIRE FUSELAGE WITH VERY SOFT STRIPS
ALL FUSELAGE FORMERS ARE MADE OF SHEET EXCEPT WHERE NOTED
SCALE IN INCHES
PLAN OF SHEET FLOOR
SHADED PORTION ON SECTIONS INDICATES FLOOR



TWIN WING

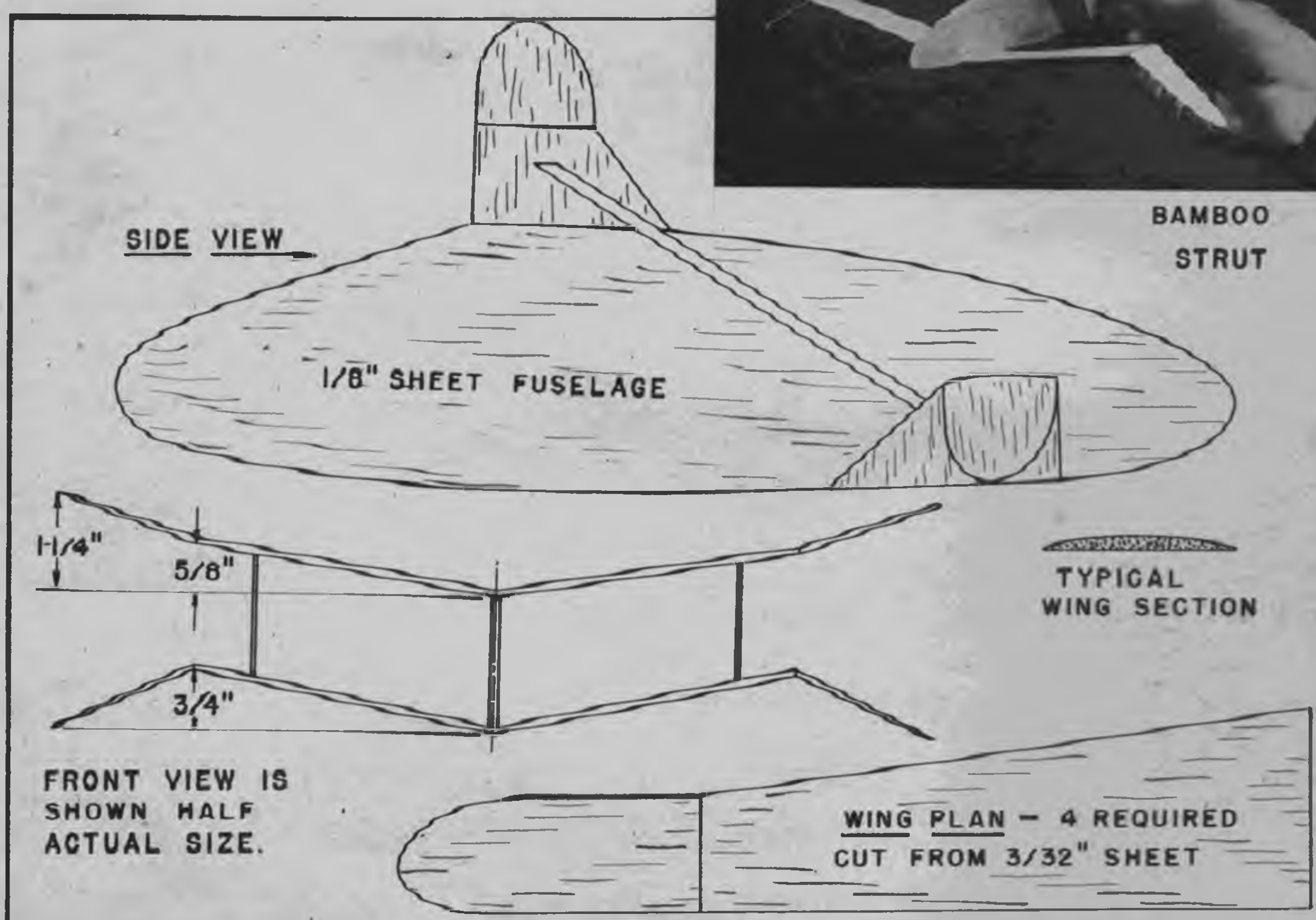
By Martin Brickner

HOW'LL YOU HAVE IT—AS A PUSHER, OR TRACTOR? BY SIMPLY CHANGING THE WEIGHT FROM THE NOSE TO THE TAIL, THIS MODEL WILL FLY IN EITHER DIRECTION.

THIS little hand-launched glider is unique in that it can be flown in either direction. Seriously, we mean it! When you get tired of flying it as a tractor, just take off the weight from the front of the model, add it to the tail and launch in the opposite direction.

The model should be built from balsa, if available, but there's no reason why soft pine or even stiff cardboard couldn't be used. When working with pine, however, reduce the wood thicknesses by 1/32" to keep the model as light as possible. The construction is a cinch; just trace the templates for the surfaces from the full-size drawings shown on this page. Then transfer outlines to sheet wood, cut out, and finish off with coarse, then fine, sandpaper.

Assemble as shown on plan, but make certain that the rear wing is cemented to the fuselage at the proper angle of incidence. Give all surfaces several coats of dope before joining together. Adjust the model in the conventional manner by adding clay to the nose; then launch it into the wind until a good glide results. To make the model circle several adjustments may be used: warp one wing tip down slightly, or add a bit of clay to a tip, or install a small trim tab at the rear of the fuselage.



Engines

IF you see a fellow walk across a field with a model under his left arm and a shotgun in the crook of his right, that's a modeler out to fly his latest gas job. Not that the average gas modeler doesn't trust his fellow human beings, but with motors as scarce as they are today, he's not taking any chances. Anyone suspected of being "light-fingered" around a gas model these days is lynched and his innocence established later. Seriously, if the modelers think they are in a spot with no new motors, think of someone trying to write a section of an annual such as this with nothing new to chin about.

The theme song this year is definitely along the lines of preservation of existing motors. Gas modelnauts who in the past used oily rags only for wiping their hands are now wrapping the rags around their motors when they aren't running them and wiping their hands on their pants! (Mothers, wives and dry cleaners reported this fact.)

For those who are going into service with the armed forces and want to keep their motors so they can fly the day they return, the trick used by one fellow now in the navy will be useful. He obtained a two-quart can with a large top and filled it three quarters full of regular automobile oil. SAE 20. Taking each motor and removing the spark plug and the gas tank and loosening the crankcase cover a bit, he submerged them gently in the oil, to rest in safety until needed. It's a good idea to rotate the shaft a few turns with the motor under the oil to make sure it gets into the engine thoroughly. Messy business, isn't it?

Another trick for "preserving" engines comes from the machine-shop trade. To avoid that messy film of oil on precision measuring instruments such as micrometers, machinists keep their instruments in a closely covered box or fairly tight drawer with a few camphor balls or flakes. We've never tried it with engines, but the success machinists have in avoiding rust and corrosion makes it worth going down to the store for a ten-cent box of camphor. We will not be held responsible for dead moths found in needle valves after the war.

Of course, there are a few fellows who aren't going into the army or navy, or who aren't too tired when they get home from the job in a war plant to do something with models. These six readers will probably be interested in some of the following notes on keeping the coffee grinders percolating.

One of the most important things has always been to use the correct fuel mixture. The quickest way to ruin the finish on a lapped piston and cylinder is to use about six or seven parts of gas to one of oil, particularly in the summertime. In the winter, some experts will recommend stepping up the mixture to four-to-one. Running a motor on this mixture may not result in undue wear immediately, but logic will prove that the thinner the mixture, the faster the wear on the moving parts. Although we have heard one expert in particular recommend four-to-one for the winter, we have also seen him use a one-to-one mixture consistently in a Forster 29 all summer. Rather inconsistent, but the mixture of equal parts of gas and oil was far better for the engine than the thin fuel.

Oil is something the boys are always wondering about. It is invariably brought up as part of a discussion on motors at a club meeting, and one of the questions most often asked is, "Why SAE 70?". The reason for the heavy oil is simply that it doesn't break down under high temperatures such as on the cylinder walls as easily as the lower viscosity oils do. When you stop to think of it, gasoline, kerosene, lubricating oils and many other products are made from petroleum by the fractional distillation of the crude oil. This process is simply the art of drawing off vapors from the heated crude at different temperatures, the result being the different products, such as gasoline, oil, et cetera. The thinner the oil is to start with the less heat it takes to break it down to a point where it is of little value as a lubricant.

If you can't locate any straight white gas, don't worry about the regular automobile gas having too much lead in it for model engines—since the war started, the octane rating has been dropped so low that very little lead is present. High-test gas should still be avoided for model engines, however. Incidentally, Series E gas-ration coupons can be obtained from your local OPA board. Bring with you the name of the engine, serial number and horsepower when applying for coupons.

With logical care, the life of present motors can be extended considerably. Using a slightly larger prop will cut down the r. p. m. of the motor and reduce wear and tear. Insulation at the breaker point becomes oil-soaked after a while; try renewing the fiber washers occasionally to keep the spark at its peak. Don't sandpaper breaker points to clean them. Points should be dressed only with a special point file obtainable for a few cents at automobile supply stores. Sanding them or using a regular file causes scratches or grooves in the face of the points, which helps increase the pitting of these surfaces. Since replacement plastic tanks are almost nonexistent, don't use a super-fuel in your regular tank.

Taking an engine apart is still the favorite indoor sport of most gas modelers. The fewer times an engine is taken apart and put together again, the less trouble you'll have. This, of course, does not apply to cleaning the engine. After a serious crack-up, it's a good idea to make sure that no dirt is in the engine.

WHY THEY RUN

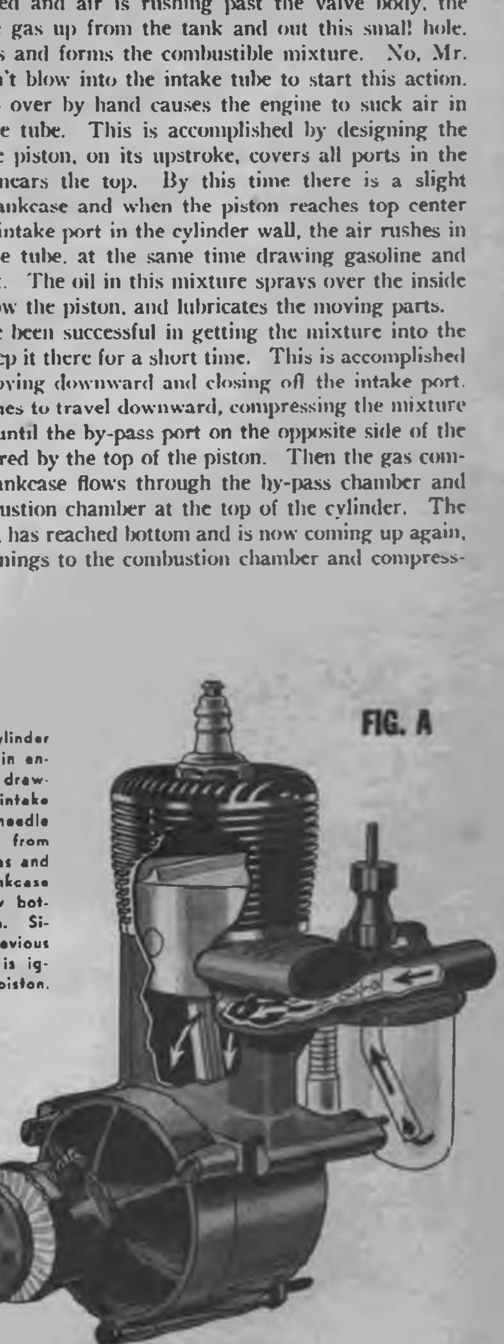
IN answer to your queries as to how a model engine percolates, we are presenting the following Cook's Tour through a typical miniature coffee grinder, from gas tank to exhaust stack.

Model motors do not have carburetors as do large engines. The mixture of gas and air is obtained by means of a needle valve in the intake tube with a minute hole in the side. When the needle valve is opened and air is rushing past the valve body, the suction draws the gas up from the tank and out this small hole, where it vaporizes and forms the combustible mixture. No, Mr. Dimwitty, we don't blow into the intake tube to start this action. Flipping the prop over by hand causes the engine to suck air in through the intake tube. This is accomplished by designing the engine so that the piston, on its upstroke, covers all ports in the cylinder until it nears the top. By this time there is a slight vacuum in the crankcase and when the piston reaches top center and uncovers the intake port in the cylinder wall, the air rushes in through the intake tube, at the same time drawing gasoline and oil mixture with it. The oil in this mixture sprays over the inside of the engine, below the piston, and lubricates the moving parts.

Now that we've been successful in getting the mixture into the crankcase, let's keep it there for a short time. This is accomplished by the piston's moving downward and closing off the intake port. The piston continues to travel downward, compressing the mixture in the crankcase, until the by-pass port on the opposite side of the cylinder is uncovered by the top of the piston. Then the gas compressed in the crankcase flows through the by-pass chamber and out into the combustion chamber at the top of the cylinder. The piston, meanwhile, has reached bottom and is now coming up again, sealing off all openings to the combustion chamber and compress-

Piston nearing cylinder top causes suction in engine crankcase, thus drawing air through the intake tube. Air passing needle valve draws gas from tank. Mixture of gas and air passes into crankcase through port below bottom edge of piston. Simultaneously, a previous charge of mixture is ignited on top of the piston.

FIG. A



ing the gas. When the piston is approximately at top center, the spark plug receives current from the coil, igniting the gas and forcing the piston down.

While the piston has been coming up to compress the gas in the combustion chamber, suction has been created in the crankcase, thereby causing the beginning of another sequence of operations back where we started this tour. The plug's igniting the gas causes it to expand rapidly and push the piston down until it reaches near bottom center. Near the bottom of the piston's route an exhaust port on the opposite side of the cylinder from the by-pass is uncovered, allowing the burned gases to pass out of the engine. The reason the burned gases can't force their way down the by-pass, which is uncovered at the same time as the exhaust port, is that compression has been built up in the crankcase by the piston's coming down, so that these fresh gases rushing out the by-pass port help get rid of the burned gases by pushing them toward the exhaust port. A baffle on top of the piston deflects the new gas upward toward the spark plug, to avoid having the burned gases trapped up near the plug and the fresh gas blowing across the top of the piston and out the exhaust before it can be burned. This action of new gases blowing the burned gases out the exhaust is generally called "scavenging."

Incidentally, the fact that gasoline and air mixture actually burns rapidly but does not explode instantaneously is the reason that a motor can be speeded up by advancing the spark till the spark at the plug occurs before the piston reaches top center. In an engine there is a slight amount of time that elapses between the spark at the plug and the moment when the burning gases reach their greatest expansion. If the spark occurs at top center of the piston, the piston has started on the way down before the most push is obtained from the burning gases. However, if the spark can be adjusted to occur before the piston reaches the top, the gases will start burning and reach their peak of expansion at top dead center, giving the piston the maximum amount of push; which, of course, results in the maximum amount of power at the propeller shaft. Starting the engine with the spark advanced is bad, however, for two reasons: 1. If the spark occurs before top dead center of the piston, and you're not turning the engine over at full running speed, the maximum push from the expanding gases will occur before the piston reaches the top and it will push the piston back down again, causing it to revolve backward. 2. This reverse action of the prop is bad on the fingers, and the sight of bloody hands is not exactly conducive to newcomers taking up the gentle art of gas-modeling.

1—COMPRESSION STROKE
Turning crankshaft forces piston upward, compressing vaporized gas in cylinder. Simultaneously, a partial vacuum is formed in the crankcase.

2—POWER STROKE
Intake port is opened; gas vapors enter crankcase. Spark plug ignites gas vapors, forcing piston downward.

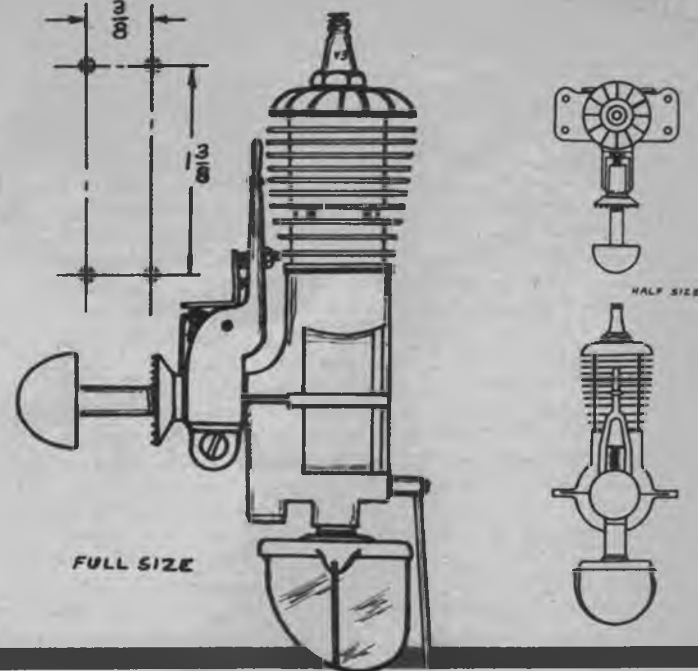
3—EXHAUST STROKE
Burning gases force piston downward until the exhaust port is opened, thus letting the burned gases out.

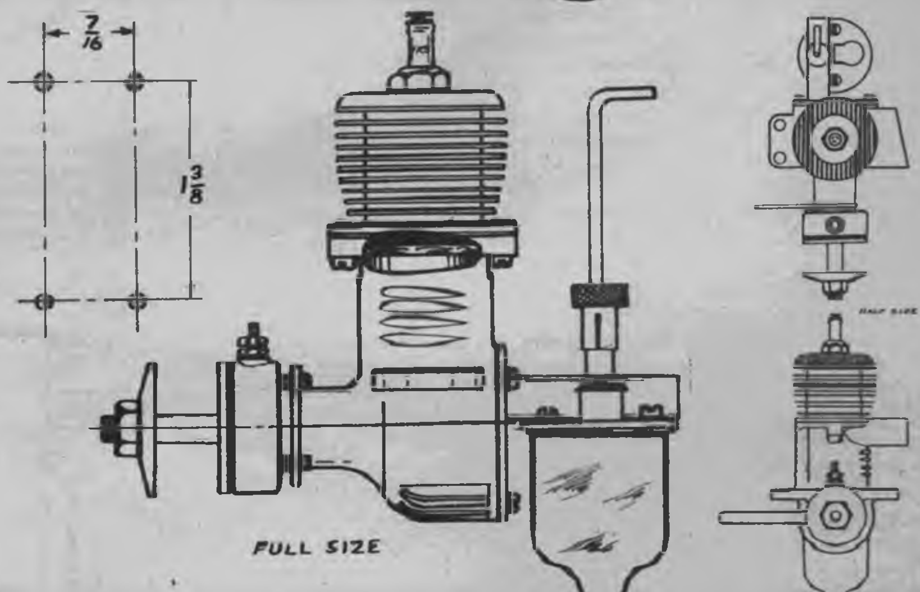
4—INTAKE STROKE
Gas vapors in crankcase have been compressed during exhaust stroke, and when piston uncovers transfer port, gases rush in, helping to force out exhaust.

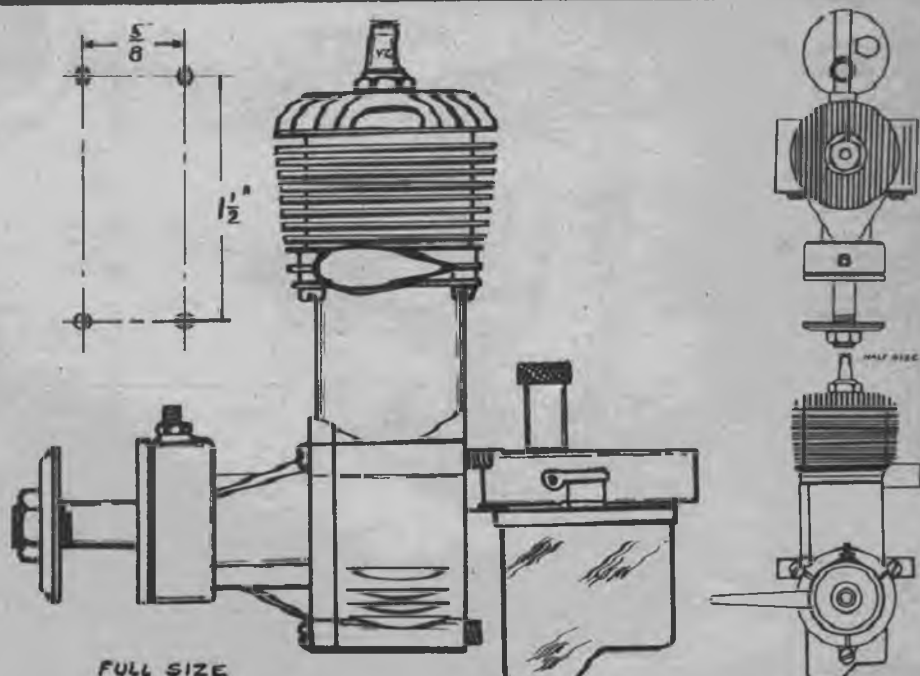
FIG. B

Mixture is compressed in crankcase as piston moves down until top of piston passes top by-pass port and exhaust port. Burned gases are pushed from cylinder by fresh compressed mixture rushing out of by-pass port. Forces of ignited mixture (sketch A) is enough to complete cycle, or in other words, push piston down, causing crankshaft to rotate.

ENGINE THREE VIEWS







FEATURES—ATOM

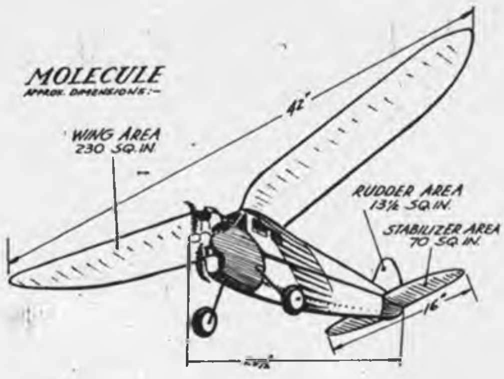
The Atom is a comparatively simple engine for beginners since it has no needle valve for adjusting the mixture. The mixture is controlled automatically by the fixed-size opening in the jet and the amount of air taken in is governed by the throttle handle, which varies the size of the air intake. As the engine is slowed down by reducing amount of air allowed to enter, the additional vacuum draws more gas mixture from the jet, richening the gas-air mixture to keep the engine from "starving" and dying out.

Construction is simple, but two points must be kept in mind—the fine jet must be kept clean, but not reamed out by an oversize wire that will enlarge hole; and the sub-piston seat on top of the piston must be kept clean to maintain compression.

One disadvantage of this size model is that the coil, condenser and batteries weigh as much as the engine. To keep the total weight of an Atom-powered model down to the contest weight rules requires the lightest type of construction and little or no pigmented dope for trim.

SPECIFICATIONS
ATOM—CLASS A

Bore	½"
Stroke	½"
Displacement	.097 cu. in.
Weight	2 ozs.
Fuel	4 or 5 parts white gas to 1 part SAE 70 oil
Spark Plug	V-3
Prop. Diameter	8-10 inch dia.



MODELS SUITABLE FOR ATOM

Baby Playboy (kit)
Piper Cub Coupe—Scale—(kit)
Itsy-Bitsy (kit)
Locust, A. T., Jan., '43
Skyfarer—Scale—A. T., Feb., '43

FEATURES—BANTAM

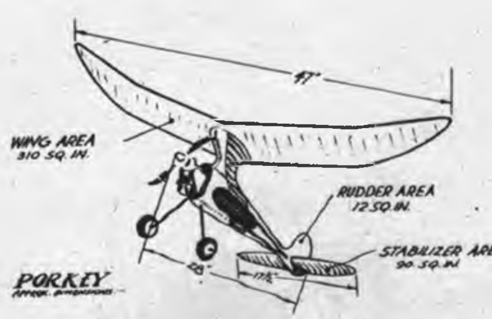
Rotary valve induction of gas mixture makes this engine easy to flood by choking. One flip of the prop is usually enough to prime the engine. The rotary valve is a disk in the back of the crankcase that needs no attention, unless dirt is allowed to enter the intake tube. This engine, through its efficient design, was found to have the highest power-displacement ratio when tested against almost every other engine on the market. This efficiency has made it one of the most consistent contest winners in modeling history.

This engine is the ideal power plant for medium-sized scale jobs that require the engine to be cowled in, particularly models of ships using a Menasco or Ranger engine.

Models the size of the Topper and the Porkie are easier to build than the smaller Class A jobs; they use sizes of wood that a newcomer can work with easily.

SPECIFICATIONS
BANTAM—CLASS A

Bore	21/32"
Stroke	.590"
Displacement	.199 cu. ins.
Weight	3.19 ozs.
Fuel	3 parts white gasoline to 1 part SAE 70 oil
Spark Plug	V-3
Prop. Diameter	9-11 inch dia.



MODELS SUITABLE FOR BANTAM

American Ace "54" (kit)
Bay Ridge Mike (kit)
Topper (kit)
Porkie, A. T., April, '43
Stormer, A. T., Sept., '43

FEATURES—FORSTER 29

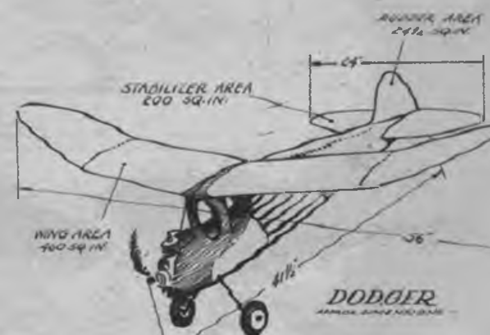
This motor is the highest powered of any engine in Class B contest competition. Although the rotary valve makes it susceptible to easy flooding, this same feature has made the crankcase compression of this engine so efficient that more than enough gas-air mixture is delivered to the cylinder for each firing stroke. This excess of gas being delivered insures complete removal of the burned gases from the previous stroke and thus the engine delivers maximum power. The only possible weak point in the motor is the screwed-on aluminum cylinder head. If taken apart and reassembled by inexperienced hands, some leakage may occur, lessening the compression.

This engine, like the Bantam, allows the cylinder to unscrew from the crankcase for cleaning the by-pass ports and passages. Care must be used in re-inserting the cylinder in the crankcase so that the screws will not start at an angle and strip the threads.

Lists of entries at contests prove this size model to be the most popular. In Class B models, the larger size airfoil gains aerodynamic efficiency advantage over the smaller models, and will still fit into a car for easy transportation to the field.

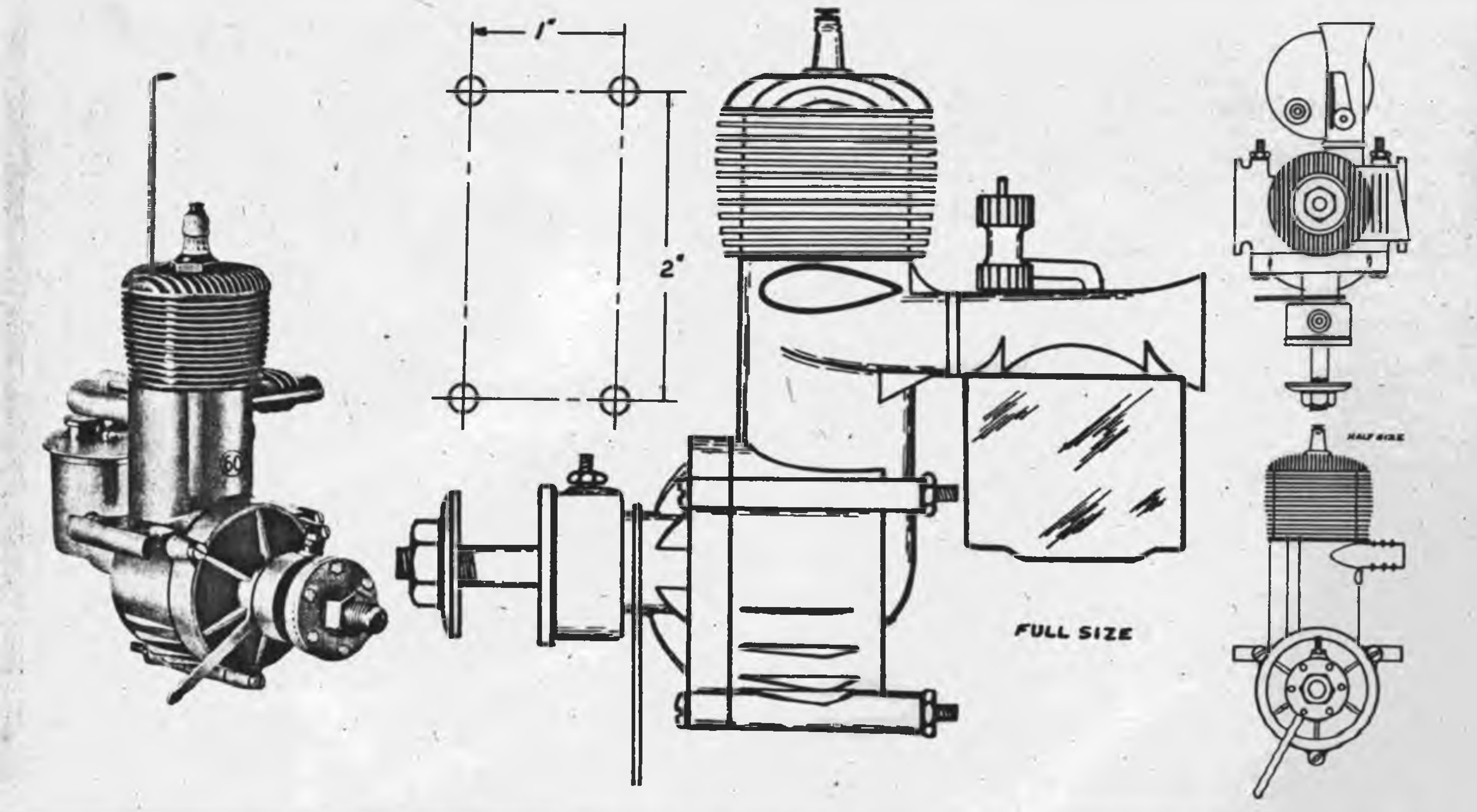
SPECIFICATIONS
FORSTER 29—CLASS B

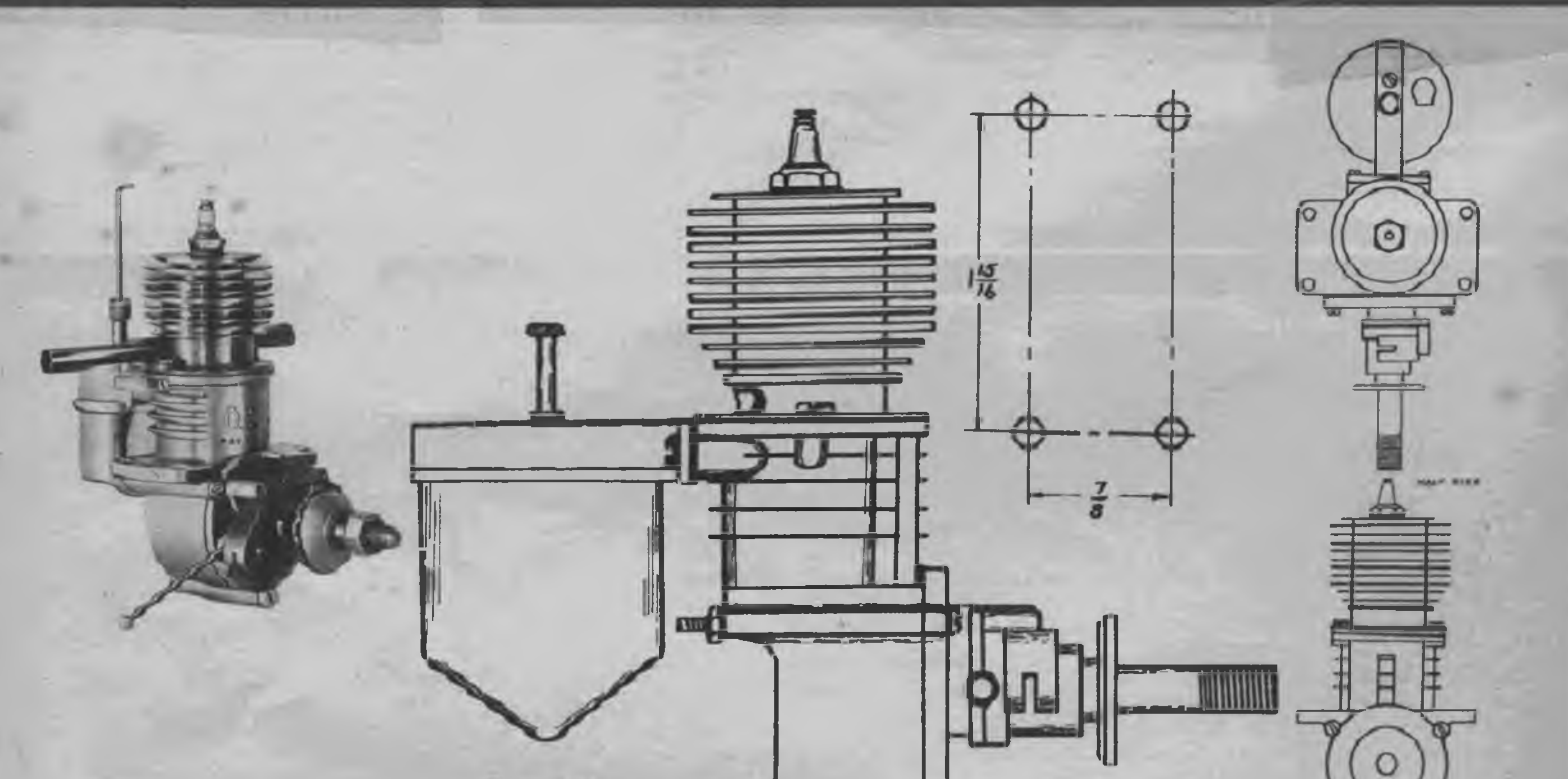
Bore	.750"
Stroke	.6718
Displacement	.297 cu. ins.
Weight	5¾ ozs.
Fuel	3 parts white gasoline to 1 part SAE 70 oil
Spark Plug	Y-2
Prop. Diameter	10-12 inch dia.



MODELS SUITABLE FOR FORSTER 29

Buccaneer "B" Special (kit)
Pacer "B" (kit)
Brigadier (kit)
Brooklyn Dodger (kit) plans A. T., Jan., '42

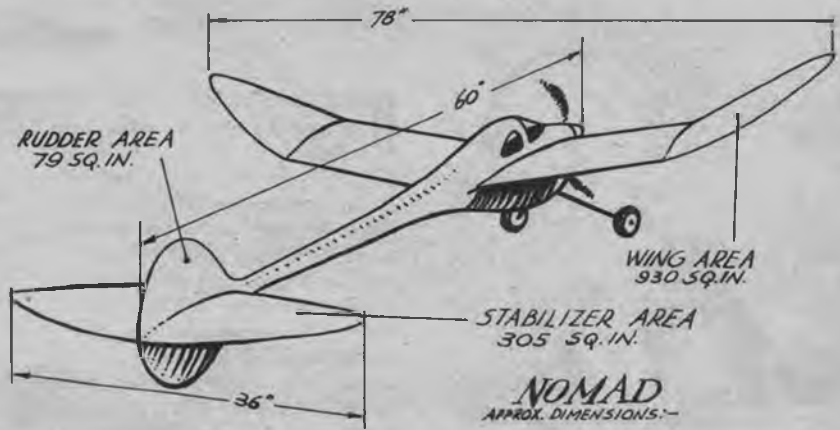

1"
2"
FULL SIZE
HALF SIZE


1 15/16
7/8
FULL SIZE
HALF SIZE

FEATURES OHLSSON 60 CUSTOM

No one who has been in modeling long will fail to recognize the name of Ohlsson. These engines have long been famous for their ease of starting and general handling. Suction intake through the side wall of the cylinder makes this type of engine less likely to flood than the rotary-valve engines. The Custom 60 has needle bearings on the crankshaft to reduce wear and a venturi-type intake tube to increase the intake efficiency. The Custom is considered the best in model engines by many, but the needle bearings make it difficult to assemble after cleaning.

The Ohlsson "60" will handle the largest sized contest-type model with ease. Many a Sailplane or Playboy has won a contest when powered with this engine. The Playboy-Ohlsson combination has placed consistently for Herman Weber, super-threat to contests in the East.



SPECIFICATIONS
OHLSSON 60 CUSTOM—CLASS C

Bore	15/16"
Stroke	⅞"
Displacement	.600 cu. ins.
Weight	9 ozs.
Fuel	3 parts white gasoline to 1 part SAE 70 oil
Spark Plug	V
Prop. Diameter	14"

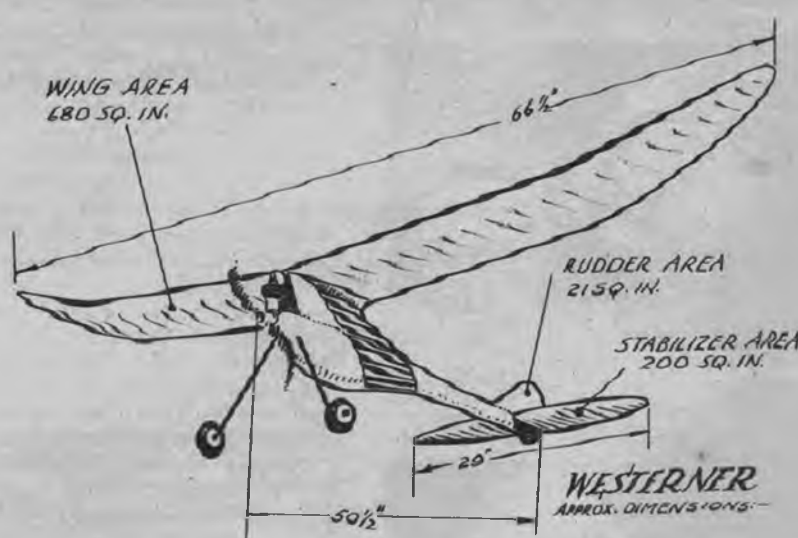
MODELS SUITABLE FOR OHLSSON 60 CUSTOM

Pacer "C" (kit)
Flagship (kit)
Playboy (kit)
Buzzard Bombshell (kit)
Nomad, Aug., '41

FEATURES HERKIMER-49

Although none of the Herkimer engines really "let loose and scream," they do deliver plenty of power. The 49 is no exception, and most Herkimer owners will contend that their engines will run longer because of the lower speed wearing the parts less. The 49 is equipped with open breaker points of the automotive type. This makes for an easy check when the timer is waiting at a contest, although opinion among modelers seems to be split between inclosed and open points. This engine is nice for that small Class C job that has to be taken to the field on a bike or in a bus.

For the fellow who wants to compete in Class C, but doesn't want to go in for ships that require a station wagon for transportation, the "49" fills the bill nicely. Ships built around the "49" will satisfy that urge for "something bigger than Class B" for the younger fellow, without necessitating materials enough to build a house.



SPECIFICATIONS
HERKIMER 49—CLASS C

Bore	13/16"
Stroke	23/32"
Displacement	.47 cu. ins.
Weight	9½ ozs.
Fuel	3 parts white gasoline to 1 part SAE 70 oil
Spark Plug	V-2
Prop. Diameter	12-14 inch dia.

MODELS SUITABLE FOR HERKIMER 49

Flyaway, A. T., Oct., '43
Mercury (kit)
Buzzard Bombshell (kit)
Buccaneer "C" Special (kit)
Westerner, A. T., Aug., '43

REJUVENATE YOUR MOTOR

By Raymond F. Yates

A good motor will have a compression of between 20 and 30 pounds per cubic inch. A tire gauge is used.

For accuracy, turn prop over rapidly while taking compression reading. Make certain engine is lubricated.

Use the gauge to test the piston for compression while it is being lapped to proper size after plating.

Lapping is made easier by replacing the connecting rod and using a steel rod through the lower bearing.

DON'T stop flying just because you can't get a new motor; old engines may be rehabilitated to give many extra hours of service. Worn bearings may be repaired by copper plating, and worn pistons brought back to size. Copper is easy to deposit and shows really amazing ability to withstand wear, but first determine how much plating is required by making these simple tests. An ordinary tire gauge should be soldered to an old burned-out spark plug that has had its porcelain insulator removed. Make certain that the soldering job is air-tight. Attach the adapted gauge to the engine, using a copper washer between the plug and engine for a perfect seal. To use the gauge, place motor in a vise and then flick the prop over quickly. An engine in good shape should show a compression reading of about 20 to 30 pounds.

Another method of testing the compression is to build a simple mercury manometer as shown in the photographs and test the engine on the exhaust stroke. Now take the engine apart and thoroughly cleanse in gasoline. "Mike up" the piston, and if your reading shows .002" wear (figures for the motor in its original condition must come from the manufacturer) it will call for a plating of only .001" which will amount to an overall plating of .002", .001" to the side. What the repairman desires is to slightly overplate the piston so that it may be lapped in carefully, using a little valve-grinding compound highly diluted with thin cutting oil. Should the crankshaft show bad wear, it, too, can be built up. In this case one must be careful not to plate the screw threads oversize. A little clear dope will prevent this and can be dissolved once the plating is completed.

Consult elementary chemistry books for the proper plating procedure, which really is very simple. Two dry cells, copper cyanide, sodium cyanide, sodium carbonate and distilled water are required. Experiments with copper "build up" showed that the original life of a motor could be considerably lengthened and in many cases the power tremendously increased.

If a pressure gauge is not available, build a simple mercury manometer. Attach rubber tubing to plug.

Parts of engine that have to be plated should be "miked up" first. Coat threads, etc., with clear dope.

A thoroughly cleaned piston being immersed in a copper bath. Consult any elementary chemistry book.

Free Flight Gas Models

AGES ago, or so it seems, modelers could fly whenever or wherever they pleased. They could attend contests every week end and build ships all during the week. Materials were plentiful and lack of money was the only priority that had to be observed.

Now conditions have changed. Although progress was not exactly at a standstill, 1943 actually saw little contributed to the gas-model field, particularly in the free-flight category. Very few really new ships appeared, and the year was distinguished principally by the re-design of old ships, using substitute materials.

Of course, Air Trails and other magazines continued to print "How to Build" articles throughout the year. For the most part the ships were conventional in trend, *but* substitute materials played a large part in their construction. Ships using pine, bass wood, and even plastic made their appearance. Worked out by experts, these ships were generally equal to prewar ships in performance and their very publication gave further proof that the American modeler was stumped by nothing—not even a war.

With AMA rules "freezing" all records, there were no new champions. But throughout the country our "underground" sent in reports of fine performances. The West coast modelers continued to turn in record flights and perhaps, if 1944 AMA rules let up on the restrictions, others will do the same.

Perhaps the most outstanding contribution to free-flight flying during 1943 was the development of the dethermalizer. With motors almost impossible to obtain, and other materials increasingly hard to get, the sight of a model disappearing into a thermal ceased to be thrilling.

The matter of dethermalizers resolved into a choice of types. Several designs proved popular, among them the type which changed elevator incidence, the type which released a small parachute, and one that changed rudder setting. However, all attained the same result: they brought a ship out of the clouds and down to the ground without injury.

Easily the best magazine ship of the year was Don Foote's Westerner, published in a recent issue of Air Trails. The model, a semi-pylon design, followed conventional practices and established plenty of records. Very few commercial gas models were introduced. What few remained on the market at the close of the year were generally re-designed to use substitute materials.

Contests during 1943 were pretty much flops. With gas rationing strongly enforced, very few modelers were able to attend the few contests scheduled. Sunday test flights were out of the question for most builders, and with model dealers going out of business by the dozen, contest chairmen found prizes hard to obtain. The motor market was shot. A black market in secondhand motors resulted in some outlandish prices—such as $50 for a "slightly used" Super Cyclone, without coil. The contests which were held saw no new records established because of flight limitations.

The Nationals, of course, were not held. Transportation difficulties, housing conditions, and general lack of top-flight modelers were important factors in the decision not to hold the National Contest. Most enthusiasts cried that the 1942 gas-model rules were discouraging to the builder, and their complaint had some basis.

However, despite the bleakness of 1943, 1944 promises to be a far brighter year for the model builder. The program of the U. S. Department of Education was launched in the schools of the country late in 1942 and really began to roll in the fall of 1943. Under this program, model building is definitely encouraged. Contests will be held when possible in each unit of instruction and the WPB has tentatively advised all and sundry that "certain materials" will be released to permit manufacture of some motors during the year. Also materials such as wire, fittings, liquids, et cetera, are expected to be more plentiful.

Experimenters did considerable work with plastics during 1943, and the interest created in the several articles published on that subject indicate that in 1944 we will see some fine plastic (or part plastic) models. Plastic, in various forms, is an ideal material for model construction. Certainly the models that will come from the use of this material will be tougher, and probably more streamlined. The process of construction—usually layers of Weldwood-coated paper, gauze or cardboard—is simple, and no critical materials are required.

Considerable interest in seaplanes was noted during 1943. The Brain Busters (of NACA, Langley Field, Va.) conducted a contest for gas seaplanes during the fall of 1943, and the directors were happily surprised at the splendid turnout. Primarily, interest in this type of ship lies in the realism of the models which taxi across the water like full-scale planes, take off, and climb slowly. Flights seldom exceed two or three minutes—making chases very easy. It is rumored that an event for this class of ship might be included in the Nationals meet, which is scheduled immediately at the close of the present world conflict.

A peculiar trend during 1943 was the flurry of activity in scale gas models. Such ships perform almost in the same manner as their full-scale counterparts, and part of the thrill in flying them comes from their realistic performance. One, two and even four-motor full-scale ships have been produced and the trend toward this particular type indicates that Scale Gas may be a very popular event at the next National contest.

A part of the decline in the free-flight gas-model field may be traced to the lack of top-flight builders. The outstanding designers, fliers and leaders in the field are, for the most part, members of the armed forces—or else they are so occupied with defense jobs that they have to neglect their former hobby. In the months to come we can expect little from such leaders, but in the days following the armistice we know they will contribute to the field their dream ships, which will no doubt be well-thought-out designs with even more ability than designs we originate at present.

No, 1943 did not contribute a great deal to model design in the free-flight field. It did add many items to the list of materials to be used, and these will be of great assistance to those who build during these war years. We know, however, that the ingenuity of the American modeler will bring forth far better ships in 1944; ships that will be smoother, better, and far stronger than their earlier counterparts. Records established in 1944 (and there will be plenty) may not be comparable to those made earlier, but they will improve, and at the same time reflect the ability of the model builder to survive restrictions.

A typical "Pencil Bomber" built by Bob Salisbury of Oceanside, N. Y. Note the similarity to indoor tractors, long moment arm, high wing, large stab.

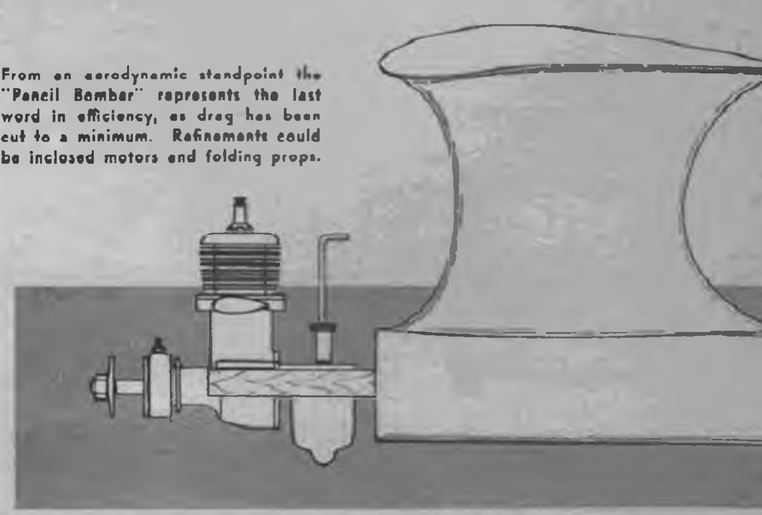
THE PENCIL BOMBER

By Peter Franklin

THE boys have out-zippered the Zipper! During the past year the Wartime A. M. A. Contest Rules have had one definite effect on the trend of models. Every modeler, of the contest-going variety, has puzzled over what he could take off his model to cut down the drag and make it more efficient aerodynamically. With no cross-section rule and with landing gears no longer being required, the boys really went to town—and the result was the "Pencil Bomber."

Gordon Light referred in an article, a short time ago, to the single-

From an aerodynamic standpoint the "Pencil Bomber" represents the last word in efficiency, as drag has been cut to a minimum. Refinements could be inclosed motors and folding props.



wheeled high-pylon jobs as "grasshoppers." What can *these* jobs be compared to? Basically, the Pencil Bomber is nothing but an engine, wing and tail connected and held in their proper position by means of as little structure as possible, in order to greatly eliminate drag. The result is a fuselage (?) that looks like a piece of broomstick with the wing held up high by a sheet of wood.

Seriously, the "P. B." is one of the cleanest types of models yet introduced to aëro modeling. The only question that keeps haunting the author is, "Why do they shove the engine out in the breeze?" Remove the engine and the ship is clean as a whistle; put the engine back in the ship to make it a gas model again and the wind whistles in all directions around the small cross-section fuselage and a good portion of that streamlined fin or pylon. The results of tests some time back showed that a streamlined fuselage with a piece of 1/8" flat rubber around it had four times the drag of the bare fuselage. Try to calculate or even approximate the amount of drag that an engine in front of a flat-faced firewall will produce.

To the unobserving, the "P. B." looks like a Zipper; actually there is a definite difference, even in the first of this new line of ships. The longer fuselage results in quite an increase in tail moment arm, with the result that the tail area is more effective. Add to this the increase in stabilizer area (to fifty percent of the wing area) and you have a ship that seems to "fly flat." The ship, when launched in a slight upward angle, seems to fly at that angle for practically the entire engine run. This increase of tail efficiency has resulted in a ship that seems to climb an inclined plane, and you find yourself looking for something that might be guiding it along this constant-angle path. The flight is entirely different from the flight of a Pacer, Zombi or other short-coupled ship. The jobs with tail closer to the wing always have a tendency to go up in a sharp spiral climb, and when the engine cuts they really snap out to a glide. The "P. B." has a climb that doesn't look as if it's going to amount to much, but all of a sudden the observer sees the engine cut, and the ship slide out of the climb and over into a glide; and then he realizes that it really grabbed altitude when under power. The "P. B." doesn't seem to snarl its way up—it's more of a steady drone.

One reason for the sensationally stable glide this type of model has is the higher aspect wing that is being used. Aspect ratios of eight or eight and a half are not uncommon. This, of course, doesn't allow the model to "roll around the prop" the way the shorter-spanned jobs will sometimes do when climbing. The wing, too, contributes to the climb "in the groove."

We believe that the Virginia boys associated with the NACA labs deserve the credit for this type of ship. Of course, others may have thought of the idea of taking the landing gear off a Zipper, but the Virginia bunch added stability through the redesign of the fuselage and tail.

Latest version of the "P. B." is a ship that seems ready to leap from the owner's hand and go tearing off into space. This effect has been accomplished by means of a pylon (streamlined by silk covering) that leans forward at the top. The latest jobs also have an increased camber on the tail surface, allowing the center of gravity to be moved aft to about fifteen percent behind the trailing edge of the wing. This has quite an effect on a person doing processing at a contest. The bewildered official tries to turn the model upside down on the wing, but it slides off the scales. Then he tries to balance the ship on the round, broomsticklike fuselage. Finally, in desperation, he turns to the contestant and growls, "Whatinell does this thing weigh?" This is quoted from experience at the last Long Island Championships—sorry if anyone took offense, but we didn't have suction cups on the scales. We'll have to suggest that contest directors obtain scales with built-in "grabbers."

The "Pencil Bombers" stole the show at a recent seaplane meet held by the Langley Field boys. Dick Everett is shown launching his Ohlsson 19 Class A hydro.

Class A and B "Pencil Bombers" of same design built by Charles Folk of Langley Field. Note characteristic long moment arm and large area stabilizer.

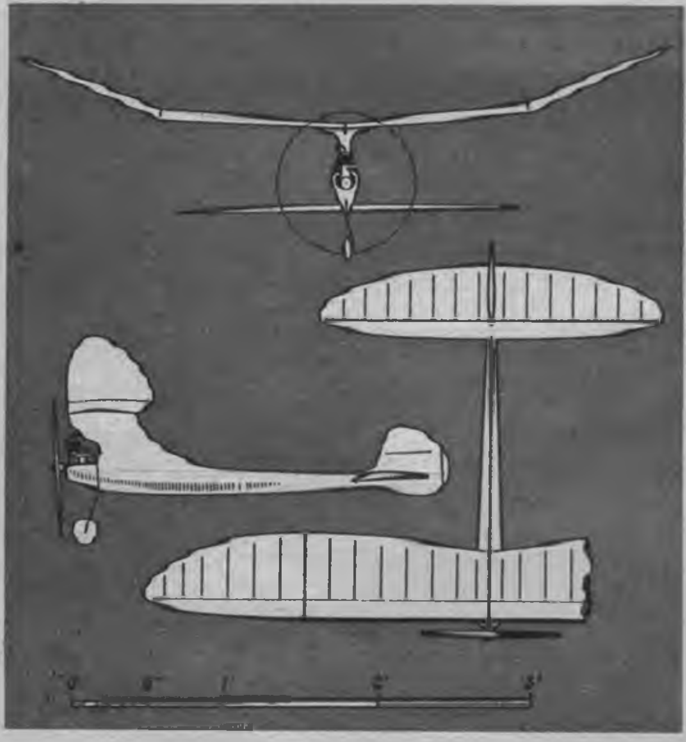
STORMER

By Ray Schofield

SCIENTIFIC DESIGN MAKES THE BIG DIFFERENCE! THIS "A" OR "B" GASSIE CLOCKS FIVE MINUTES ON A FIFTEEN-SECOND MOTOR RUN.

THE Stormer is the second model of this general design. The original was built in 1942, weighed twenty ounces and had the same wing area as the later model. Powered by an Ohlsson 23, it had a rapid climb and was sensitive to the slightest updraft.

Using the same specifications, slight revisions in design were made—mainly a change in wing plan and a general reduction in drag. The Stormer incorporates these changes.



Some of the principal factors which govern stability are the locations of the (1) center of lift, (2) center of gravity, (3) thrust line, (4) line of resistance, (5) center of lateral area; these being relative to one another. Since adequate lateral, longitudinal and directional stability plus favorable spiraling characteristics were desired, the force arrangement was worked out in detail as one of the initial steps in the design of the model.

WING: The wing area is 324 square inches, average chord is six inches, span is fifty-four inches. And the aspect ratio is nine to one. This ratio has proved very efficient and is not so great as to cause structural problems.

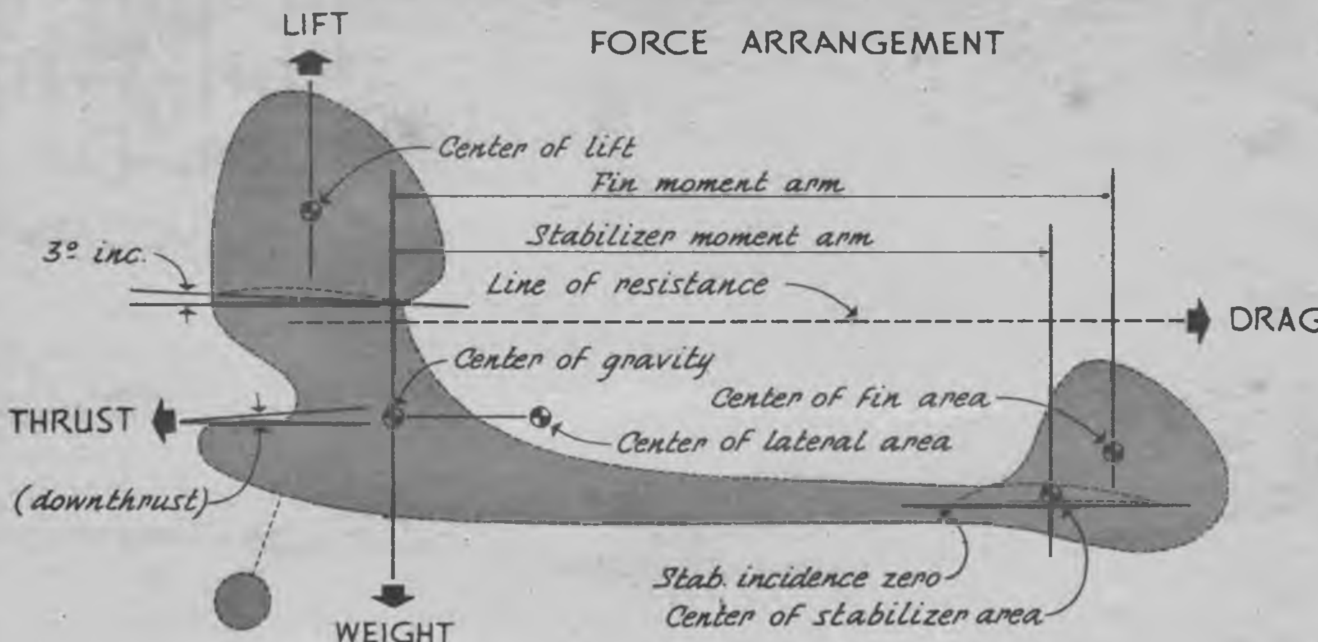
The Davis No. 4 wing section was selected because it is similar to the reliable N. A. C. A. 6409. Leading-edge sheeting and use of capstrips assure an efficient section throughout the wing.

Since the broadest part of the wing is toward the tip, and this area is higher than the center section because of the dihedral, the center of lift is quite high.

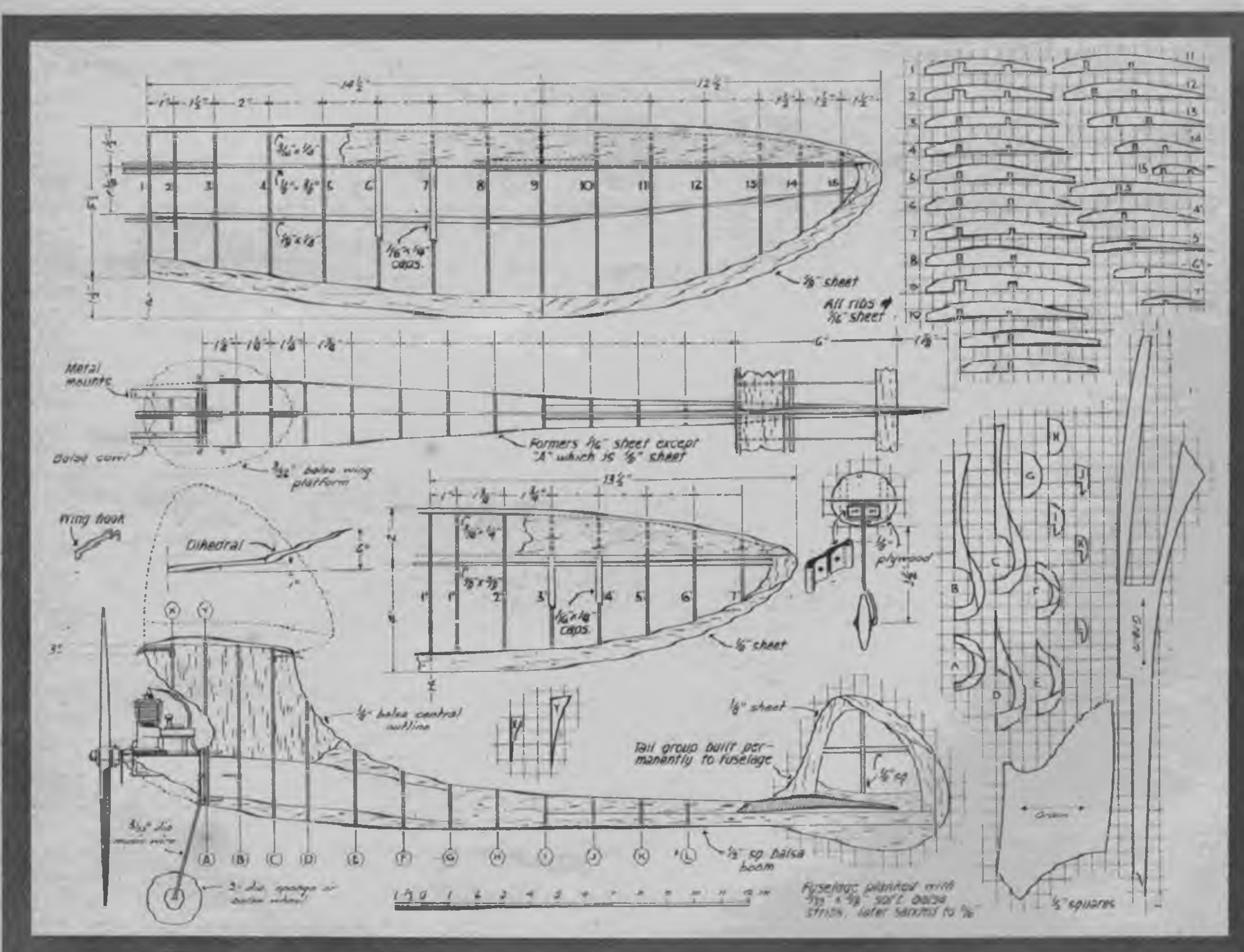
These efforts toward wing efficiency were worth while, for the model has a fast rate of climb, yet a safe climbing angle, a slow, flat glide and great stability even in gusty weather.

STABILIZER: The stabilizer area is 122 square inches, average chord is four and a half inches and aspect ratio is six to one. Use of a high-lift stabilizer section gives structural as well as aerodynamic advantages. Pleasing elliptical curves mean more to a model than merely an improvement in appearance. So for appearance, efficiency and for strength, elliptical outlines are used.

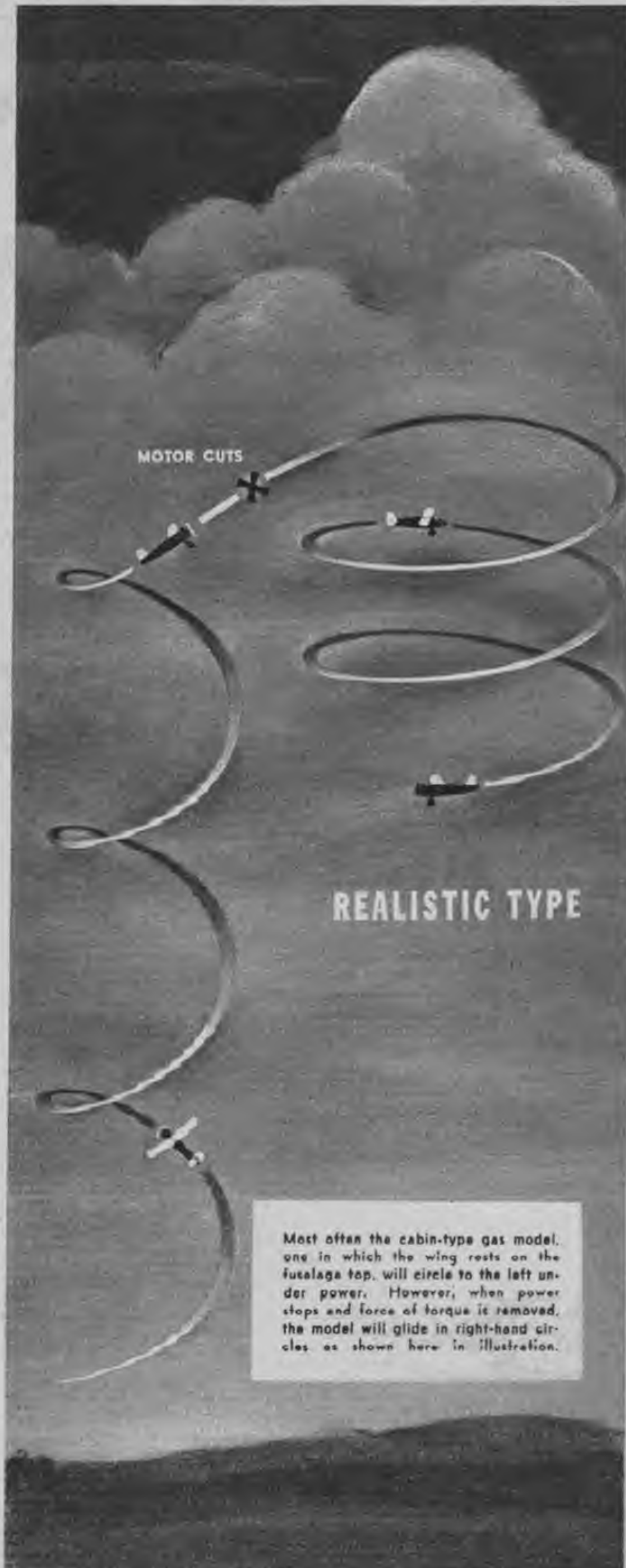
FUSELAGE: The fuselage has a high thrust line, a high wing mount, and is approximately thirty-two inches long, depending on the engine used. To minimize drag and for adequate strength the general fuselage section is round. General fuselage lines, the height of wing mount, location of center of lateral area, et cetera, were all determined by the force arrangement. Slight downthrust is used which causes the thrust line to be slightly above the center of gravity. As indicated on the sketch showing force arrangement, the model balances well toward the wing trailing edge.



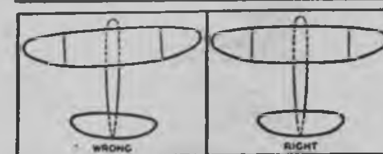
Wing area - 100 %, Stabilizer area - 38 %, Fin area - 7½ %



ADJUSTING

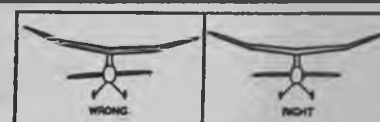


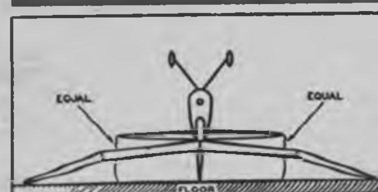
Most often the cabin-type gas model, one in which the wing rests on the fuselage top, will circle to the left under power. However, when power stops and force of torque is removed, the model will glide in right-hand circles as shown here in illustration.



From the top view, one wing or stabilizer tip should not slant forward. Misalignment means erratic flights and causes crack-ups.

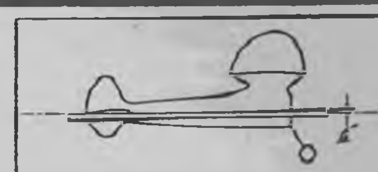
Wing and rudder should line up when viewed from the front. A little care here means satisfaction of many good flights later.

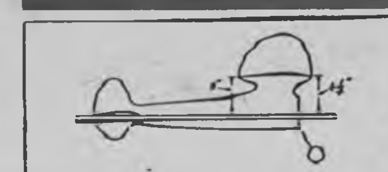




Method of checking above step is shown here. Model is inverted. Small wood strips are placed along edges of wing platform for adjustment.

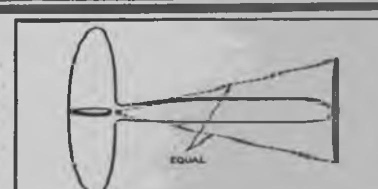
On Zipper positive incidence is called for in the tail. To check amount of incidence, use yardstick inclined 1/32 inch at the front.

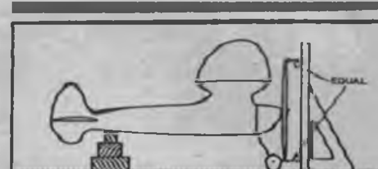




Yardstick checks incidence to see that leading edge is ¼" higher than the trailing edge. More incidence in the wing than in the tail.

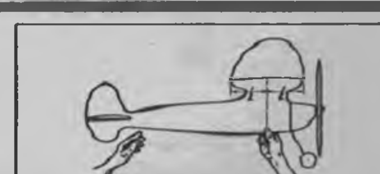
Very important is this check to see that the propeller is not pulling either to right or the left. Measure distance as shown.





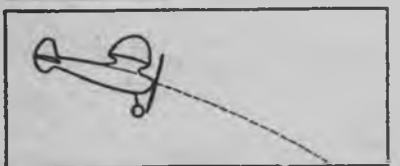
Next repeat the test from the side view to make sure that propeller does not lean either forward or backward. Use triangle as shown.

On a Zipper-type model with lifting-type tail, ship should balance at midpoint of the wing. Measure as shown, balance on hand.



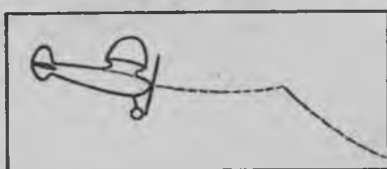
AND FLYING

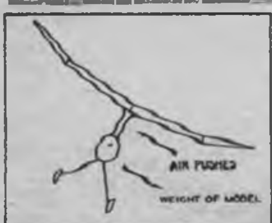
Line illustration courtesy Comet Model Airplane & Supply Co.



Test glides come next. Make a few runs holding model into wind to get feel of ship. Then aim at spot 50 to 100 feet ahead; release.

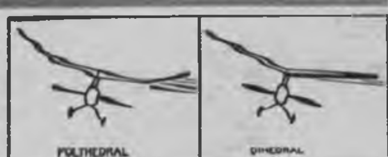
If the model should stall, move ignition box forward. In the event of a nose dive, the opposite adjustment of weight is required.





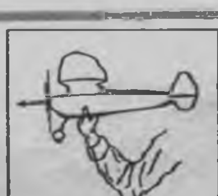
Due to high pylon, Zipper-type models are inherently stable. If ship banks in glide, check for misalignment or a heavy wing.

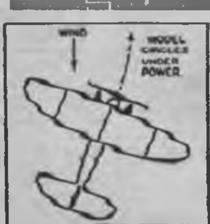
This illustration shows function of the pylon and dihedral to bring the model out of sideslips. Note polyhedral is even more effective.



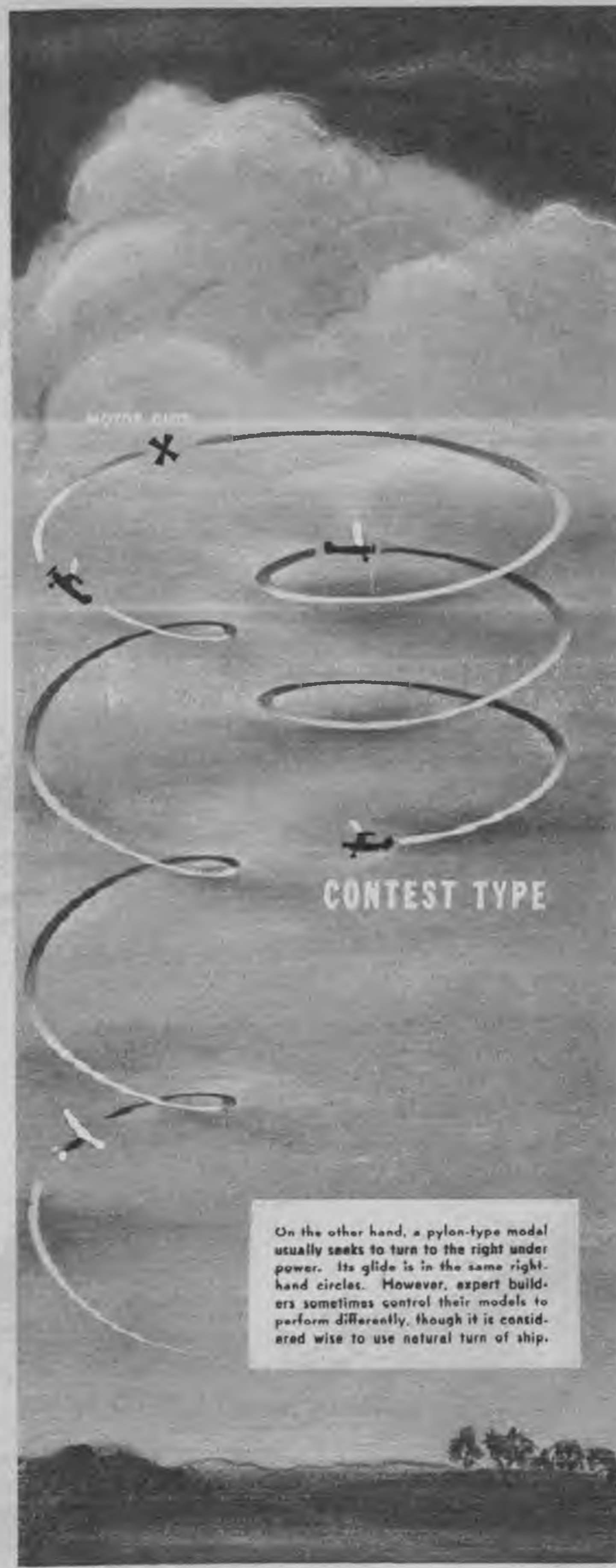
For first power tests run engine half open, with slightly rich mixture to prevent "leaning out" from stopping engine. Run and launch.

This is proper launching angle. By no means point nose of ship upward. Don't throw; release surely and smoothly forward.



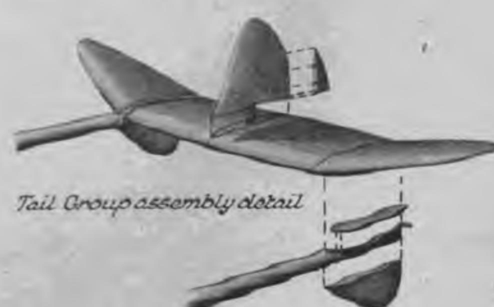


When you launch model make it turn under power into the wind. Wind should be blowing on the inside of ship's power circle.



On the other hand, a pylon-type model usually seeks to turn to the right under power. Its glide is in the same right-hand circles. However, expert builders sometimes control their models to perform differently, though it is considered wise to use natural turn of ship.

Boom attachment detail



Tail Group assembly detail

Outer Wing Panel attachment detail

Typical Spar-Former assembly

Wing and Upper Pod section attachment detail.

TWIN BOOM

By A. R. Bertill

THIS UNUSUAL CLASS C GASSIE, DEVELOPED FROM A SERIES OF SIMILAR DESIGNS, HAS AVERAGED OVER THREE MINUTES ON A FIFTEEN-SECOND MOTOR RUN FOR SIX CONSECUTIVE NON-THERMAL FLIGHTS.

HERE'S a streamlined soarer of unique design that's tops in all kinds of competition. It is the fourth in a series of boom jobs designed and built by the author in the last three years. The original design, first conceived in the winter of 1940, incorporated a straight gull-wing center section and used an upright Dennymite for power. This model had exceptionally fine performance qualities and was flown in several contests around Minneapolis. This first model, however, did not have a chance to prove itself a contest winner as it was demolished when it crashed into some high-tension wires and plunged into a concrete highway. The second in the series was built in the summer of 1941, and with minor changes mounted two Ohlsson "23's," one in the front of each boom. This model was tested and flown in several contests that summer and proved quite successful. This model was discontinued because of the high cost of losing both motors in case the model should be lost. The third in the series had several minor revisions, including a curved gull center section and a longer span. It mounted an inverted Ohlsson "60" in the streamlined pod. An attempt was made to incorporate flaps as dethermalizers. This, however, proved unsuccessful because when they extended, the lift coefficient of the wing was changed, which resulted in a very violent stall. This model is the one shown in the pictures. It had an exceptionally flat glide which has been measured several times at 16.1. This is undoubtedly due to the high aspect ratio of the wing, the aspect ratio being 11.6 to 1. This is exceptionally high for a contest ship, and at first some difficulty was encountered in building the joints between the outboard and the center-section wing panels strong enough. However, the method shown in the plans has proved highly successful and has never failed the author yet. The latest of the ships in this line was designed last spring, and the only change from the previous one was that a Super Cyclone was used in place of the Ohlsson "60." The same tail surfaces and outboard wing panels were used on all four ships.

The design of the boom job is unique in that it incorporates a very high-lift tail section with the center of gravity located quite far back on the chord of the wing. The stabilizer has built-in dihedral to raise it out of the downwash of the wing. The airfoil used in the stabilizer is a Grant X-8 mounted at a negative angle of incidence. The airfoil used in the wing is the conventional Goldberg airfoil which has proved itself so successful in the Zipper and other ships of that line. The idea behind the utilization of these two airfoils was that the Goldberg, being a high lift airfoil at relatively high speeds, would lose its lift when the model approached a stalled condition sooner than the Grant X-8, which is a high-lift airfoil at relatively slow speeds. This would eliminate extreme stalls, because when the model nosed up sharply and slowed down, the wing would lose most of its lift, while the stabilizer would not. This design angle was proved in all four of the ships in this series, as none of them have ever had a tendency to stall with the ensuing steep dive following the stall. Instead, if the model begins a stall because of faulty adjustment, the nose slowly drops until the glide angle and speed have been restored. This happens with but little loss in altitude.

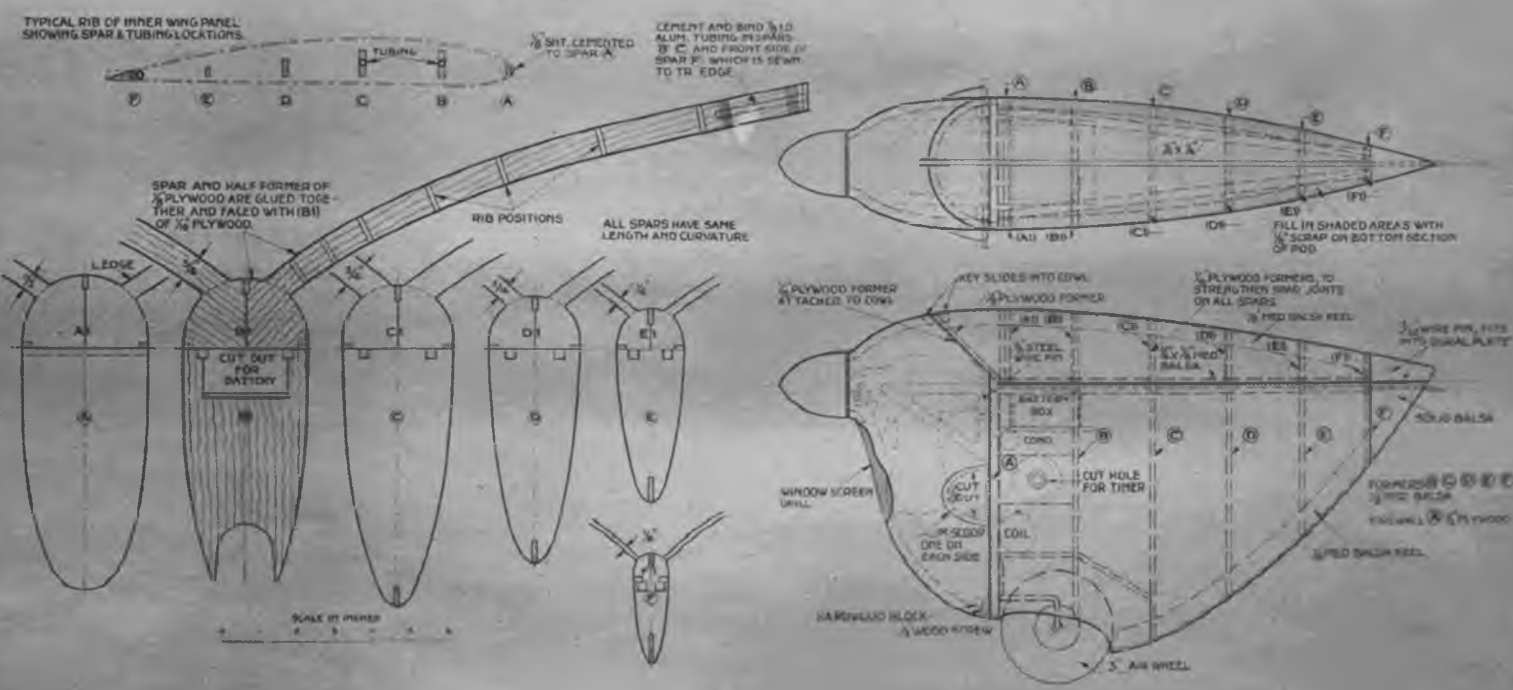
The thrust line and the chord line of the wing are co-incident. The center of gravity is located two inches forward of the trailing edge of the wing. The model should be test glided and adjustments made until a fairly flat glide is obtained. Power flights should then be tried with the motor idling and final adjustments on the glide made. The power should be increased slowly on succeeding flights until full power is reached. The desirable climb is a wide right circle with the ship going up at an angle of about forty degrees. The glide should be flat, with the booms in a horizontal position. The glide circle is about three hundred feet in diameter.

The weight of the completed model should be about sixty-four ounces, which gives it a wing loading of 11.6 ounces per square foot.

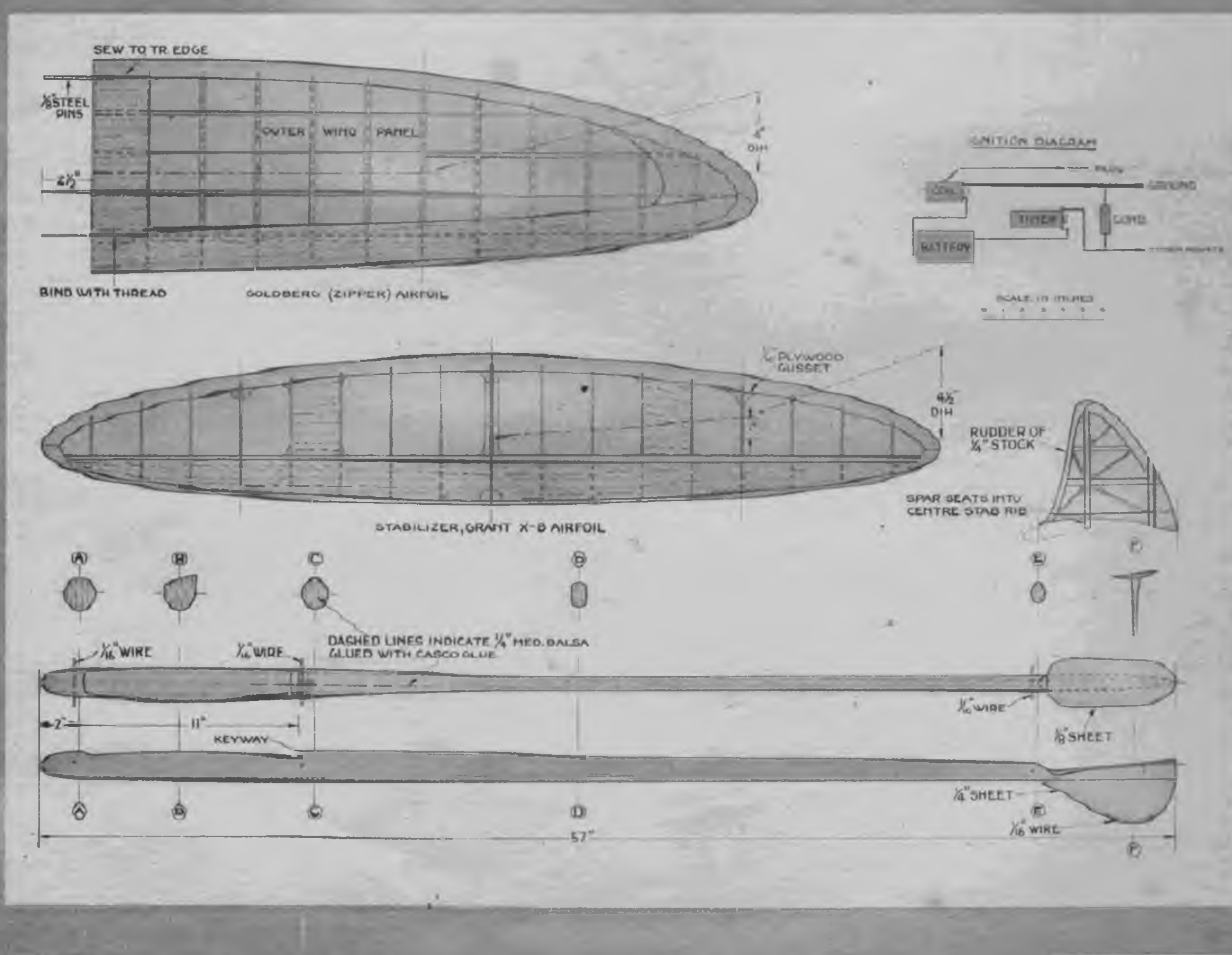
The author's model averaged three minutes and fifteen seconds on a fifteen-second motor run for six successive flights with no thermals.

This front view shows pod detail. Originally, dethermalizer flaps were used on wing, but caused a stall when lowered. Gliding angle measured at about 16.1.

TWIN BOOM



TYPICAL RIB OF INNER WING PANEL SHOWING SPAR & TUBING LOCATIONS
TUBING
CEMENT AND BIND
TO TR. EDGE
SPAR AND HALF FORMER OF
RIB POSITIONS
ALL SPARS HAVE SAME LENGTH AND CURVATURE
LEDGE
CUT OUT FOR BATTERY
FILL IN SHADED AREAS WITH
KEY SLIDES INTO COWL
BATTERY BOX
COND.
COIL
CUT HOLE FOR TIMER
SOLID BALSA
WINDOW SCREEN
3" AIR WHEEL



SEW TO TR. EDGE
STEEL PINS
OUTER WING PANEL
DIH
BIND WITH THREAD
GOLDBERG (ZIPPER) AIRFOIL
IGNITION DIAGRAM
GROUND
COIL
TIMER
COND.
BATTERY
PLYWOOD GUSSET
DIH
RUDDER OF ¼" STOCK
SPAR SEATS INTO CENTRE STAB RIB
STABILIZER, GRANT X-8 AIRFOIL
WIRE
DASHED LINES INDICATE ¼" MED. BALSA GLUED WITH CASCO GLUE
2"
11"
KEYWAY
⅛" SHEET
¼" SHEET
57"

Construction

DURING the past year the ingenuity as well as the imagination of model builders has had free rein. Materials such as balsa wood have become scarcer and scarcer, but with the return of well-cut hardwoods to the dealers' shelves, the active modelers have not found themselves too handicapped. True, a model of hardwood construction takes longer to build—part of this increase in time being due to the fact that many modelers have been accustomed to building ships of nothing but first-grade balsa. Becoming familiar with the technique of using hardwoods to advantage in construction has required more thought. Fellows who had always cut tips from balsa suddenly found that tips cut from pine weren't easy to make and split too readily. The simplest way to build models these days is to make the straight pieces such as spars, stringers, longerons and the like from the hard wood and make the difficult pieces from balsa. Most dealers still have some balsa wood on hand. Those who have sold their "prewar" stock are finding ways of getting pieces that are left from the construction of life rafts, et cetera, and cutting them into sheets. These sheets are small, usually about 2" wide by 24" long, but the bulkheads, curved wing tips and fairing pieces can be made from them.

More and more fellows are starting to look into the idea of molded models; this can be partly attributed to the shortage of easily worked balsa. There is also the trend toward greater streamlining in models. Model designers' thoughts are turning toward the sleekness of the modern metal airplane and this is re-

NOW, PLASTIC MODELS

By Ed Yulke

NEW TECHNIQUE IN MOLDING AND MAKING FORMS BRINGS THE TRUE PLASTIC STREAMLINED MODEL AIRPLANE ONE STEP NEARER ACTUALITY.

AFTER trying out various combinations of paper, cloth, gauze and the new plastic cements, we found the best results were obtained by using strips of newspaper and a mixture of half dope and half cement with one ounce of castor oil per quart of mixture. The castor oil prevents the dope from shrinking. The celluloid and paper shell resulting from this method is better able to take landing shocks than the shells made with the new commercial "plastic" glues on the market. Since these new plastic glues set by chemical reaction, nothing could be found to plasticize them. This lack of a plasticizer resulted in too brittle a shell, one that cracked if the model landed at all hard.

Greasing the form well with vaseline will eliminate the necessity of borrowing a power chisel to remove the shell from the form. An additional safeguard along these lines is to just wet the first layer with water, instead of doping it in place. The vaseline and then the wet layer will act as two separation points for the shell and form. If the dope penetrates through the wet layers, there won't be much left to go through the vaseline.

On a form for a cowling of a C Class engine, it was found that ½-to-¾-inch-wide strips were best for the long curves, and ¼-inch-wide strips for the short curves. In building up the shell, overlap each strip halfway onto the previous one laid on. Layers should cross each other for maximum strength and smoothness. Wrap one layer around and then lay the next lengthwise.

Six to eight layers were found sufficient for a C Class cowling. Complete fuselages would require more layers around such points as the firewall and landing gear, but less back at the tail sections. U-control fuselages can be built with twice this number if desired, since the weight is not so critical as in free-flight models (and the shocks are harder). In a lower cowling for a Typhoon model, the completed cowl weighed one ounce and had approximately twenty square inches of surface. This cowl was eight layers thick and was complete with wood filler and colored dope.

flected in their efforts to design smoother-looking models. For a streamlined fuselage, the plastic shell can't be surpassed. Then, too, the shell-type model is not subject to punctures every time a gust of wind catches it just as it is being picked up to be launched. Paper-covered fuselages have always been a headache in that respect.

U-control, guide-line, or whatever you care to call it has really caught on in the last year. Here, at last, is a chance for the scale-model builder to create something that will be in keeping with his ideas of realism and still be able to fly. Although speed events are the most popular at present U-control meets, stunting, precision landings, balloon bursting and the like are close followers-up in popularity. In the latter half of 1943, more and more rumblings were heard that sounded very familiar. The scale gang were starting to become more active and taking to U-control. The last time sounds like these were heard, rubber-powered flying scale was beginning to take the country by storm. Judging from the popularity of flying scale U-control plans, we should see quite a few in contests next season. There is no reason why a speed model can't also be a flying scale job. This, of course, will depend largely upon the rules, or should we say that the amount of detail, the scale, and the weight will depend largely upon the rules. Certainly a model of the Typhoon with the engine inclosed presents less drag than a Fireball with the same Ohlsson 60 out in the breeze.

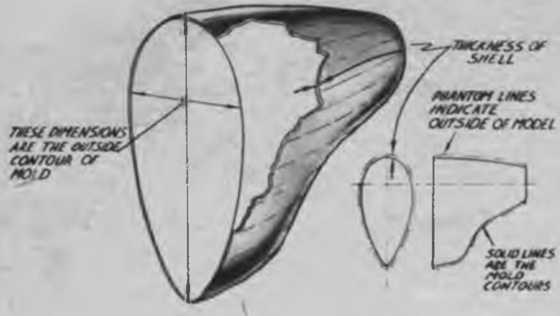
Speaking of U-control jobs, every so often we hear of someone working on the idea of retractable landing gears, working flaps, and other gadgets. Working flaps will allow a much higher wing loading on guide-line models and a safer landing speed, and eliminating the drag of the landing gear will increase the speed of the model quite a bit.

Returning to thoughts of construction and burning the midnight oil over a new ship—despite the abundance of talk about shortage of materials, we still find sufficient cement, dope, paper, and wire on hand in most of the hobby shops. True, the cement and dopes sometimes reek to high heaven of alcohol, indicating that they are ersatz in composition, but most of these new formulas will still do the job. Paper in colors may not be readily obtained everywhere, but there is the old trick of getting a box of tinting dye at the drugstore, dipping the white paper, and ironing when dry. Nothing will ever erase the memory of a ship at the Eastern States Championships a few years ago. The fuselage was mauve and the wings and tail were a delicious shade of cerise. The builder had wanted to use silk and still not add the weight of colored dope, so the result was shades of dye that were meant for a lady's boudoir.

Salvaging the landing-gear wire from a cracked ship has become common practice among modelers since the disappearance of the really tough "music wire" grade of $^3/_{32}$" and ⅛" diameter wire from the hobby shops. The new wire is strong enough, but a hard landing sometimes springs the gear bow-legged. Additional care in anchoring the wire to the airplane will allow you to bend the wire back to its original shape without tearing a few pieces of the structure with it. Plywood is still the best backing for a landing-gear attachment.

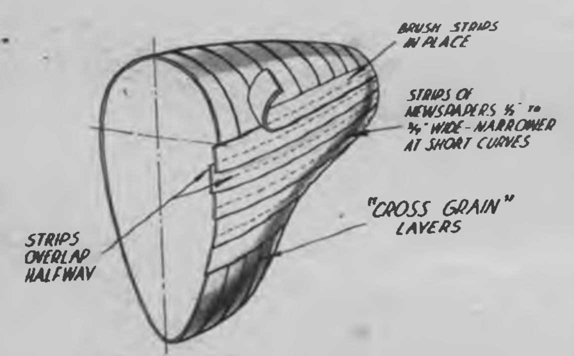
Many people have lamented the fact that rubber wheels and the like are scarce. What all the shouting is about, we fail to see. Wheels, unless they are chewed up by too close contact with the prop, will last indefinitely. The writer still has a pair of 2⅝" M & M's (from a ship built three years ago) that still hold air for more than a few days. If the wheels are kept free of gas and oil, and their exposure to the sun is not long enough to affect the rubber, they can be used on one model after another.

One result of this war is really encouraging, so far as modeling is concerned: with so many model builders working in defense plants, nuts and bolts to hold engines in are plentiful. Engine hub nuts and mounting nuts are now of the latest army-and navy-approved type. It's too bad more defense plants don't use dope and cement, to say nothing of balsa—the model builder's construction problems would be solved.



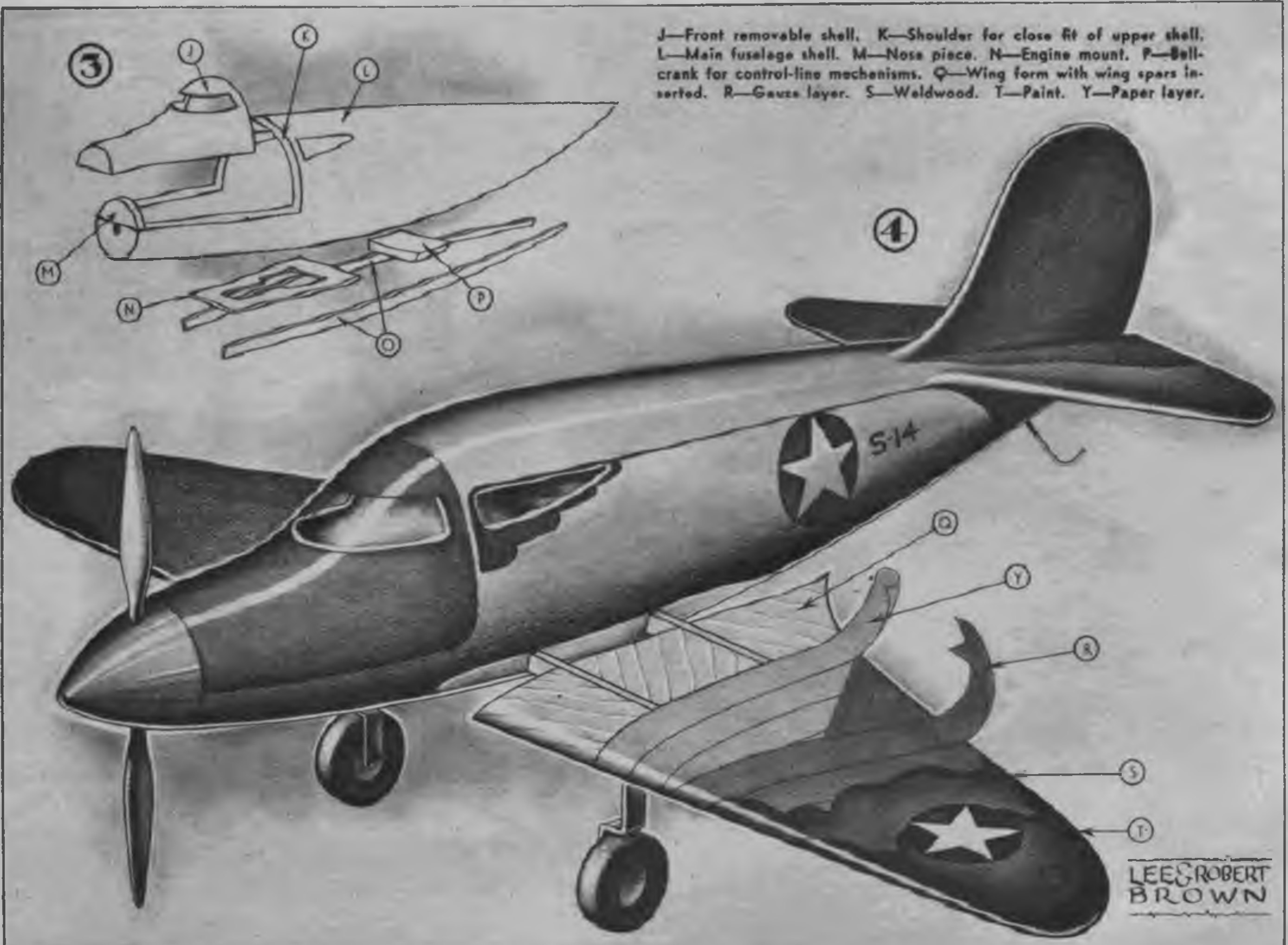
1. Assembling cardboard patterns for form. Do not shellac the frame or plaster will not stick.

2. Rough in with plaster. When dry, smooth with additional plaster, leaving a surplus to take a sanding later.

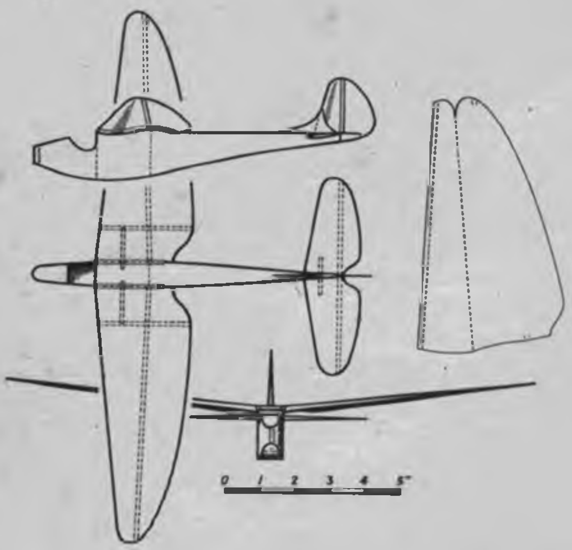


3. After first layer of paper strips is in place, dope on more layers, smoothing with the fingertips.

4. Finished form and sample cowling shell. Shell smoothness depends on surface of form. Finish, paint shell.



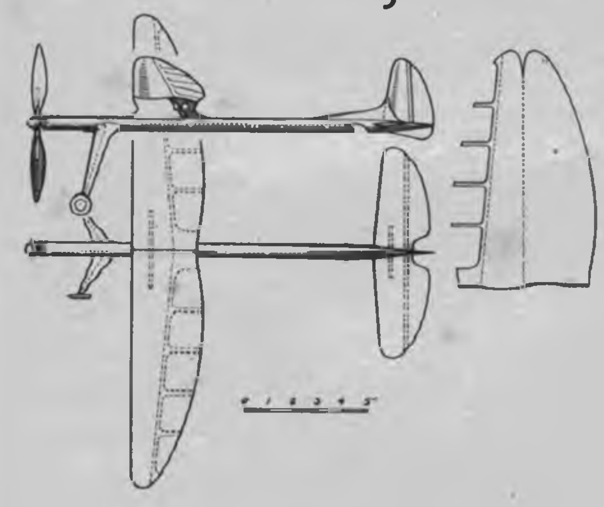
J—Front removable shell. K—Shoulder for close fit of upper shell. L—Main fuselage shell. M—Nose piece. N—Engine mount. P—Bellcrank for control-line mechanisms. Q—Wing form with wing spars inserted. R—Gauze layer. S—Weldwood. T—Paint. Y—Paper layer.



TRY PAPER MODELS

WHY LET THE MATERIAL SHORTAGE HAMPER YOUR BUILDING? TRY PAPER CONSTRUCTION FOR A SUBSTITUTE. THEY'LL REALLY FLY.

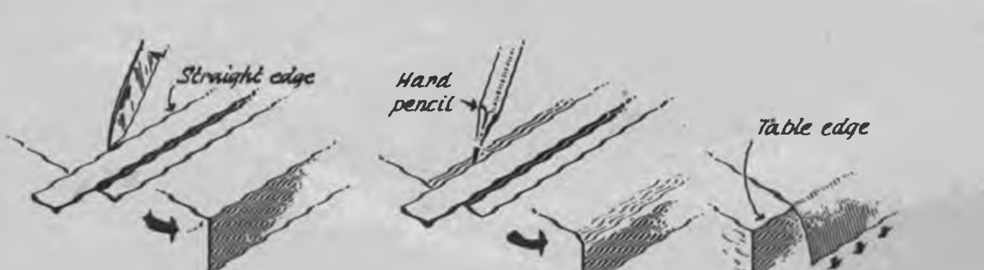
By H. A. Thomas

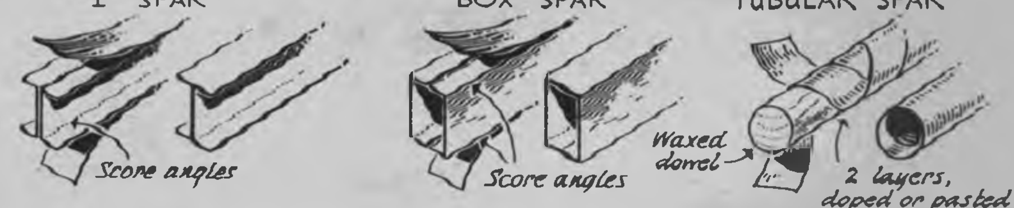


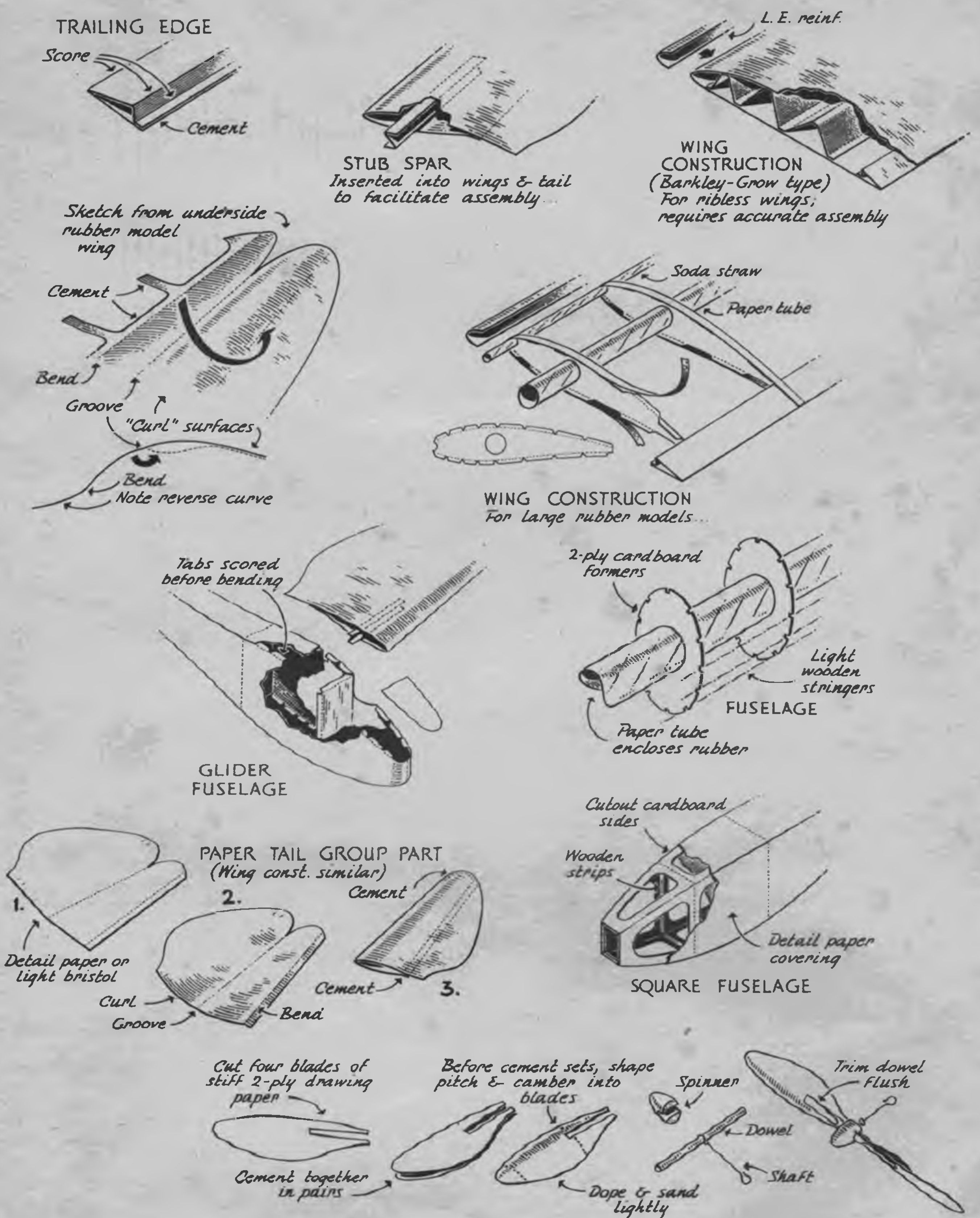
THE real potentialities of paper as a construction material, aside from toys and novelty models, have largely been overlooked. But paper can be used to produce good-looking, sturdy, flyable models as proven by the illustrated glider and neat-looking rubber model. Both these models are good performers and took only about an hour to build.

The problems encountered in the use of paper closely follow those found in the use of sheet aluminum in real aircraft construction; for paper, like aluminum, must be cut to the proper outline, shaped, stiffened, and fastened to form wings and other parts. It can best be used when combined with fittings and parts of other materials for supporting strength. Papers best suited for model building include detail paper, the various thicknesses of bristol board (one, two and three ply), light and heavier cardboard and, possibly, corrugated cardboard for certain gas-model parts.

The accompanying sketches show various ideas for adapting paper to model construction. Most of these have been tested, while others are included to indicate the broad possibilities of paper as a construction medium. Our experiments with light-paper construction lead to stronger, larger and heavier parts for gliders and rubber jobs with up to three-foot spans. The success of these attempts indicates that a gas model could be made entirely from paper. Don't be stymied by the lack of materials or time; see what you can do with paper models. You'll find it absorbing—with all sorts of possibilities to investigate.






TRAILING EDGE
Score
Cement
STUB SPAR
Inserted into wings & tail to facilitate assembly...
L. E. reinf.
WING CONSTRUCTION
(Barkley-Grow type)
For ribless wings; requires accurate assembly
Sketch from underside rubber model wing
Cement
Bend
Groove
"Curl" surfaces
Bend
Note reverse curve
Soda straw
Paper tube
WING CONSTRUCTION
For large rubber models...
Tabs scored before bending
GLIDER FUSELAGE
2-ply cardboard formers
Light wooden stringers
FUSELAGE
Paper tube encloses rubber
PAPER TAIL GROUP PART
(Wing const. similar)
1.
Detail paper or light bristol
2.
Curl
Groove
Bend
Cement
Cement
3.
Cutout cardboard sides
Wooden strips
Detail paper covering
SQUARE FUSELAGE
Cut four blades of stiff 2-ply drawing paper
Cement together in pairs
Before cement sets, shape pitch & camber into blades
Dope & sand lightly
Spinner
Dowel
Shaft
Trim dowel Flush

The progress of American aviation is depicted by these wind-tunnel models of the Barling bomber of the early 1920s and the modern Consolidated B-24.

WIND TUNNEL WARRIORS

AT WRIGHT FIELD, ONE OF THE ARMY'S TEST LABORATORIES, WIND-TUNNEL MODELS OF PLANES TO COME FORECAST THE AXIS DEFEAT.

Today's dream ship may be tomorrow's fighter. This new design, featuring the propeller mounted behind the tail, is being attached to instruments.

Pfc. F. B. Johnson used to make models for a hobby, now turns out accurate wind-tunnel models for army. Details of design shown were not disclosed.

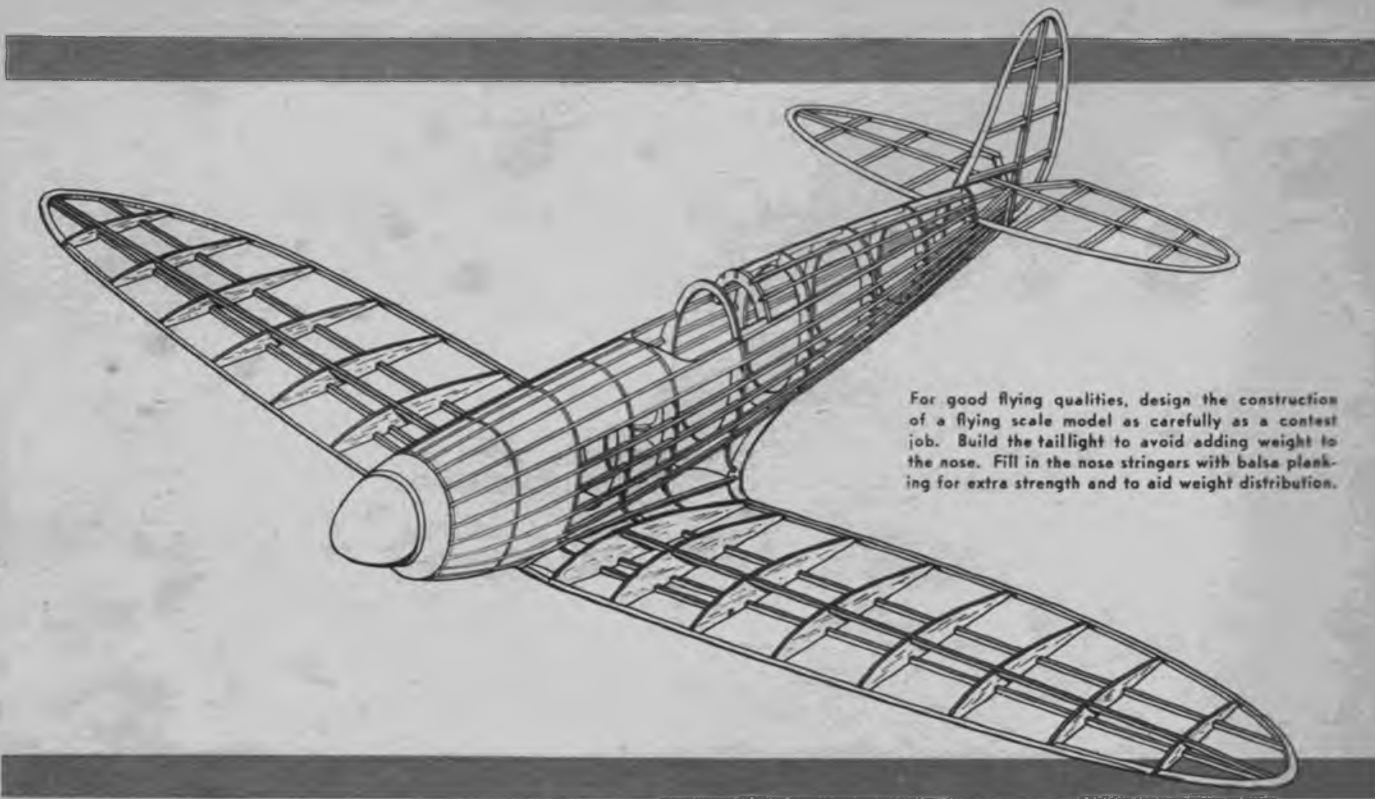
Models vary in size, and often just parts of a proposed design are tested. Shown here is a P-40, P-37, and the engine nacelle model of a B-15 bomber.

When photos are taken of this model P-47 being tested in the wind tunnel, cotton tufts cemented to the wings and tail will show flow over the surfaces.

Flying Scale

OVEREMPHASIS of strictly flying-design rubber- and gas-powered models in contests throughout the country in recent years has brought about an unwarranted condition of neglect in the building and flying of scale and semiscale models. Much of this favoritism must be attributed to the desire for maximum flight performance, since little need be said of the relative appearance of a neatly built scale ship and the usual contest design. In reality, however, a properly designed flying scale is potentially capable of making completely stable flights of favorable duration. Because of the amount of detail that can be embodied in a flying scale, construction is most interesting, and through proper structural layout the model can be made durable and sturdy. It is the purpose of this article to point out basic aerodynamic and structural items in the designing and building of these realistic miniatures.

Selection of a suitable modeling subject is the first problem in the creation of a scale model which can be expected to render excellent flight performance. It is the accepted belief that high-wing planes make better prototypes than low-wing ships, but this is not true in every case. Qualities that make a plane



For good flying qualities, design the construction of a flying scale model as carefully as a contest job. Build the taillight to avoid adding weight to the nose. Fill in the nose stringers with balsa planking for extra strength and to aid weight distribution.

suitable for reproduction as a model are: generally favorable over-all proportions, tail surfaces of ample size, sufficient dihedral and a landing gear long enough to provide clearance for a large propeller. Many low-wing planes possess these characteristics and are, therefore, logical selections. An example of this is the author's North American P-51 which, after hundreds of flights over a period of a year and a half, still makes highly stable flights of more than one minute forty seconds.

Once the builder has decided to model a specific design, it is frequently difficult to obtain the required outline drawings. Manufacturers at one time co-operated very readily in satisfying such needs, but at present it is almost impossible to tap that source. For that reason it is usually necessary to resort to small three-view outline plans as published in *Air Trails*. In most cases these have been carefully prepared from authentic sources so are sufficiently accurate for the modeler's needs. The larger ones can be increased in size with the aid of draftsman's dividers while the smallest ones must be enlarged, to some extent at least, photostatically. Needless to say, photographs are of great value when preparing such plans, and in some cases they may even be scaled directly to fill in details.

It is the opinion of the author that a flying scale model having a wing span of twenty-eight to forty inches with an area of from 125 to 175 square inches is best. A ship of this size is adaptable to strong, realistic construction and at the same time it is large enough to employ an efficient wing section and effective propeller. Unlike the mammoth scales of near-gas-model proportions, these medium-size models are easily handled when winding and flying.

After the model's size has been decided upon, and the outline plans are drawn to actual scale, several minor but highly important readjustments in the design may be required. It is seldom indeed that a builder will find a modern plane with tail surfaces of sufficient proportions to insure the desired stability required of a model. No hard-and-fast rules will be volunteered by this writer for adjusting the areas exactly; however, it has been found from experience that a rudder area equal to twelve percent of the wing's area will assure directional stability, while a stabilizer twenty-five to thirty percent of the wing area will maintain the required longitudinal stability. A plane with a long tail moment arm will remain stable with a bit less area, while one with a short tail moment arm will require more.

In addition to being of sufficient area, the stabilizer must be set at a lesser angle than the wing in order to facilitate climb or recovery from a drive. Normally, this angular difference between wing and stabilizer is two and a half to three degrees. On a regular high-wing plane, such as a Stinson or Taylorcraft, tests have demonstrated that best flights are obtained when the stabilizer is set at an angle of plus one degree. Adding to this the three-degree larger angle of the wing, places it at plus four degrees. A plane of midwing design or a high wing with extremely high line of thrust will perform well with the stabilizer at zero degrees. Many builders have never mastered the secret of obtaining flights equal to a high-winger from a low-wing ship. Without a doubt, much of this trouble can be traced to incorrect setting of the flying surfaces. A low-winger set up in the same manner as the conventional top-decker, with the stabilizer set at zero or slightly positive, will have a tendency to climb very little, if not, in fact, to dive at the start of the flight. Then as the power diminishes it will zoom skyward, usually ending in a stall as the rubber is exhausted. From this attitude it will descend in a galloping glide. Eliminating this inherent tendency is comparatively simple, and the solution again lies in the correct angular placement of wing and stabilizer. By setting the stabilizer at a negative angle relative to the thrust line (from experience minus one to one and a half degrees), then placing the wing the normal two and a half to three degrees more, the wing will be at an angle of plus one and a half degrees. A low-wing model, otherwise correct in design and adjustment, will have

Neat covering jobs are acquired only through patient practice. Round fuselages, such as this Vanguard, should be covered lengthwise with small strips of tissue.

performance comparable to a ship of more conventional design when it incorporates this feature.

As in the case of tail-surface proportions, dihedral of the wings must frequently be increased; this brings about improved lateral stability. However, many low-wing prototypes have sufficient dihedral and in this event no change will be required on the model. On high-wing types $\frac{5}{8}$" dihedral per foot of span is about right, while a low-wing ship needs a little more—$\frac{7}{8}$" per foot proving ample. Incidentally, these figures represent the whole span and the amount of dihedral under each tip.

Another major factor in obtaining excellent flight performance from any model, flying scale or otherwise, is an efficient propeller. The importance of this cannot be overemphasized, therefore every effort should be made to incorporate a large, effective prop. Clearance provided by the landing gear usually limits the length, so on many flying scales blade width must be vastly increased to insure ample area. It is a good rule to make the propeller length at least one third the total span of the wing and even more if possible; remember the adage "big props for performance."

It has been the practice of the author always to design the fuselage assembly so that when the wing and tail surfaces are attached to it, they will fit exactly at their proper positions and at the planned angles. This may be accomplished on certain types by making a wing rib an integral part of the fuselage or by providing a flat surface to which the wing and tail may be directly attached. On a low-wing model employing the keel and bulkhead method of construction, one of the best ways of aligning the flying surfaces is to shape the lower keel so as to conform with the wing's upper surface, and then at the rear do likewise with the tail-surface mount.

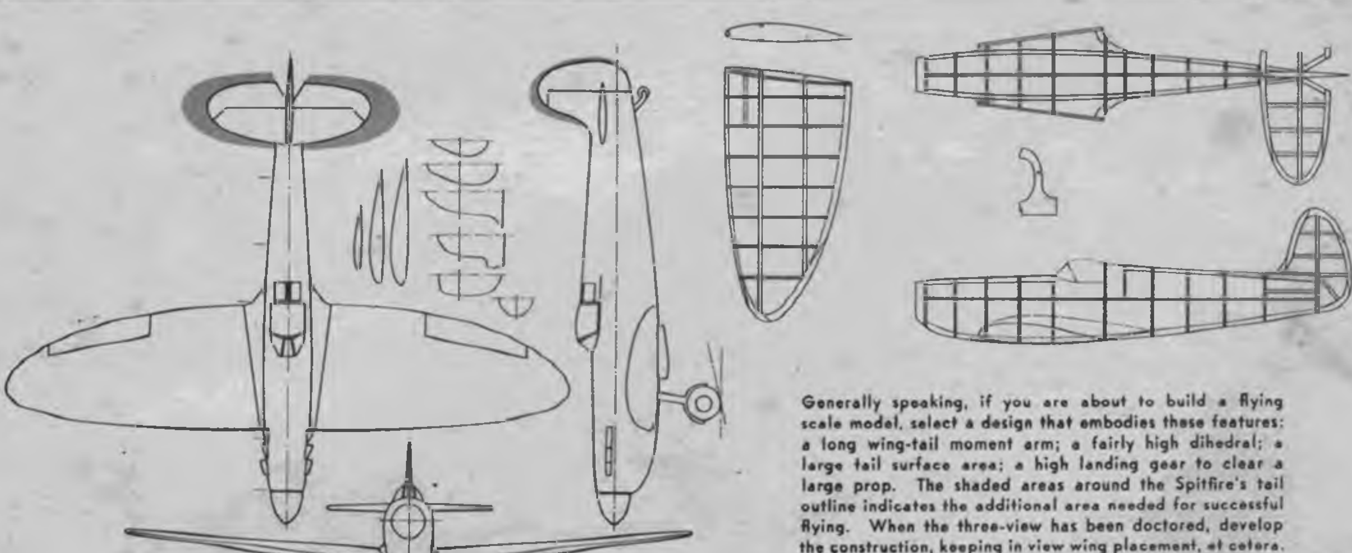
Actual construction methods are well known. For fuselage, two types are most popular. An under frame of rectangular cross-section to which small formers and stringers are attached is best for slab-sided, simple, fuselages such as on the Fairchild 24, Stinson "Reliant" or Cub. Depending on the model's size, $\frac{1}{16}$" square to $\frac{1}{8}$" square balsa, pine or spruce is used for longerons and cross members, formers are of light, thin stock and fairing stringers are usually $\frac{1}{16}$" square strips. Planes with sleek, rounded bodies such as the Airacobra, Warhawk or Wildcat can be made in much the same manner, but the keel-and-bulkhead form of construction is much more adaptable. Here, four keels are cut from thin sheet to conform to the fuselage outlines (top and bottom of side view and two sides of top view) and these are fitted into notches in the bulkheads. Method of assembly is simple. Pin the top and bottom keel directly to the plan and then cement half of the bulkheads, which are made in two pieces, in place. Attach a side keel in the notched bulkheads and then when

Contrary to popular opinion, low and midwing jobs will prove good fliers if the design has good over-all proportions such as large tail area and ample dihedral.

dry remove this frame from the plan and add the remaining bulkhead halves and keel. Now the fairing stringers are fitted to the notches in the bulkheads; these are attached in pairs to avoid drawing the fuselage out of alignment. Many times a model will need weight in the nose in order to bring the center of gravity into position. In this case, rather than having to add dead ballast later to the front, it is best to cover the cowling with sheet or fill it in with scraps. Not only will this improve the appearance, but it will also strengthen the nose. Another very worth-while feature is a removable nose plug that will enable the propeller assembly and rubber motor to be pulled out for adjustments, winding and repairs.

Every effort should be made to make the wing as efficient as possible. If the airfoil section is inefficient or the covering is sagged to excess or is wrinkled, poor performance will result. In most cases the scale airfoil is not reproduced, for very few modern planes have a wing design suited to the slow flight of a model. The Clark Y or similar airfoils are most adaptable to models, and in the event that the builder places excellent flights before authentic appearance, an undercambered wing section can be used to good advantage. Light ribs, closely spaced, will help preserve the desired airfoil shape and a leading and trailing edge of generous size, as well as sufficient spars or a single spar of ample strength, will provide the required rigidity.

In all cases it is desirable to keep the tail of the model as light as possible; this will reduce the amount of weight required in the nose (and thus the model's total weight) to bring the center of gravity to the desired position. However, be sure to construct a rudder and stabilizer strong enough to resist warping. Some builders prefer to



Generally speaking, if you are about to build a flying scale model, select a design that embodies these features: a long wing-tail moment arm; a fairly high dihedral; a large tail surface area; a high landing gear to clear a large prop. The shaded areas around the Spitfire's tail outline indicates the additional area needed for successful flying. When the three-view has been doctored, develop the construction, keeping in view wing placement, et cetera.

make the control surfaces of the tail, as well as the ailerons on the wings, movable, but this is unnecessary.

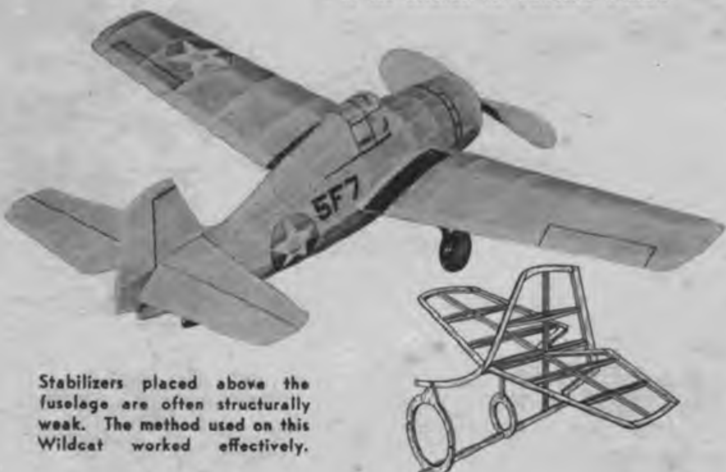
A neat, colorful covering job and finish is a necessity for any flying scale model. Colored tissue, if used skillfully, will result in a lighter job than if pigmented dope is used to color the tissue. In most cases it is best to cover the parts individually before they are assembled: however, before any covering is applied all frames should be sanded lightly to remove flaws and roughness. Curved parts, such as the fuselage, wing tips, et cetera, must be covered with numerous small pieces of tissue, neatly lapped to make a wrinkle-free job. Tighten the covering first by lightly spraying with water, then brush on clear or colored dope. Many details, such as control-surface outlines, flaps, doors and the like, are effectively represented by thin strips of black tissue, while other items such as exhaust ports, air scoops and wheels are made from scrap materials.

The correct amount of rubber strand needed to power various models is determined by the ship's weight and the propeller length, pitch and efficiency. Too little power will result in a slow flight at low altitude, while too much will make the ship unstable or cause it to climb very rapidly, but with a very short motor run. Flights of longest duration will result when the model climbs efficiently with a reasonable power run to an altitude sufficient to permit it to take advantage of its good gliding ability. The rubber strands should be lubricated with a mixture of tincture of green soap and glycerin, and to achieve maximum power the motor must be wound with a winder.

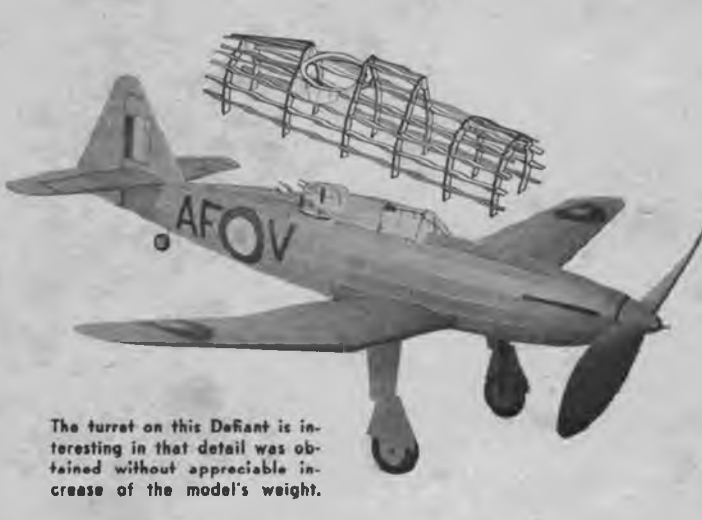
It is seldom indeed that any model will "fly right off the workbench," for, assuming that it is of sound design and good construction, the degree of success of the little ship's flight performance depends largely on correct adjustment. With this in mind, endeavor to achieve the maximum fruits from your labors. Before going to the flying field, bring the center of gravity into approximate position by adding any required corrective weight to the nose or tail; normally, the model should assume a slightly nose-down attitude when suspended by the fingertips at a point halfway on the wing chord. Select a calm day and a grassy field for testing. Before using any power, try a few shoulder-height glides; the descent should be smooth and easy. Any small readjustment of the center of gravity can be made at this time to correct the glide as required, also the tail surfaces or wing tips may be warped very slightly to achieve the desired results.

Once satisfied with this phase of testing, power may be applied. Use but a few turns at first, gradually increasing them as flights become more satisfactory. Strive to achieve a fast climb which gradually flattens, as power decreases, until it ends in a smooth glide. Even while testing with power, confine all weight and slight warping adjustments to the glide; the power flight attitude is controlled by offsetting the thrust line. A few degrees of right thrust created by placing small wood splints between the nose plug and nose, thus offsetting the thrust line slightly, will aid in controlling the circles while under power. Also a tendency to stall or mush at this time may be eliminated by tilting the thrust line down. This correspondent prefers to have his planes adjusted so they circle to the right throughout the flight; first with full power the turn is wide and the climb steep, then with a smooth change from power flight to glide the turn tightens to a floating spiral. Once your model is flying well, don't be content to leave it unchanged but rather experiment to determine for yourself the secrets of adjusting and flying that can be gained only by experience.—*By Earl Stahl.*

Making a landing gear "stay put" bothers many builders. The sketch is the solution for Fairchild Trainer.



Stabilizers placed above the fuselage are often structurally weak. The method used on this Wildcat worked effectively.



The turret on this Defiant is interesting in that detail was obtained without appreciable increase of the model's weight.

This semiscale Mustang features a removable wing by using dowels, cemented across the two bulkheads, and elastic bands. Note the construction.

sharp was the competition that even tiny infractions had to be corrected. At Bendix, N. J., the scene of the last Wakefield finals, held just before the war, Dick Korda was required to add several pennies to the bottom of the fuselage—his solution to the necessity of adding more weight and cross section as required by the rules. Tail area, too, was limited. Korda was compelled to shave off one sixteenth of an inch along the trailing edge of the tail to conform to area limitations. He won, however, with a terrific flight of approximately forty-five minutes. The English that year had all the bad breaks, but, of course, congratulated Korda heartily. Gordon Light, then model editor for *Air Trails*, won the Wakefield twice, once by a proxy pilot who won the meet in Britain with the first flight—right out of the box, so to speak. Competition fostered good designs and engendered many new ideas. The pictures on this page show but a few of the really clever designs that made the last competition at Bendix such an outstanding contest and pleasant memory.

CANADA—Lavalle Walter's entry averaged 150 sec. Model was very stable.

FRANCE—John Zaic proxy flew Andre Vincre's model which had a fine glide.

NEW ZEALAND—Vernon Gray's neatly built model cracked up on trial flight.

SOUTH AFRICA—These models were marvels of workmanship but overweight.

The '39 Wakefield contest was over almost before it started. Dick Korda's first flight, in fact the first of the contest, set a record of 43 min., 15 sec.

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