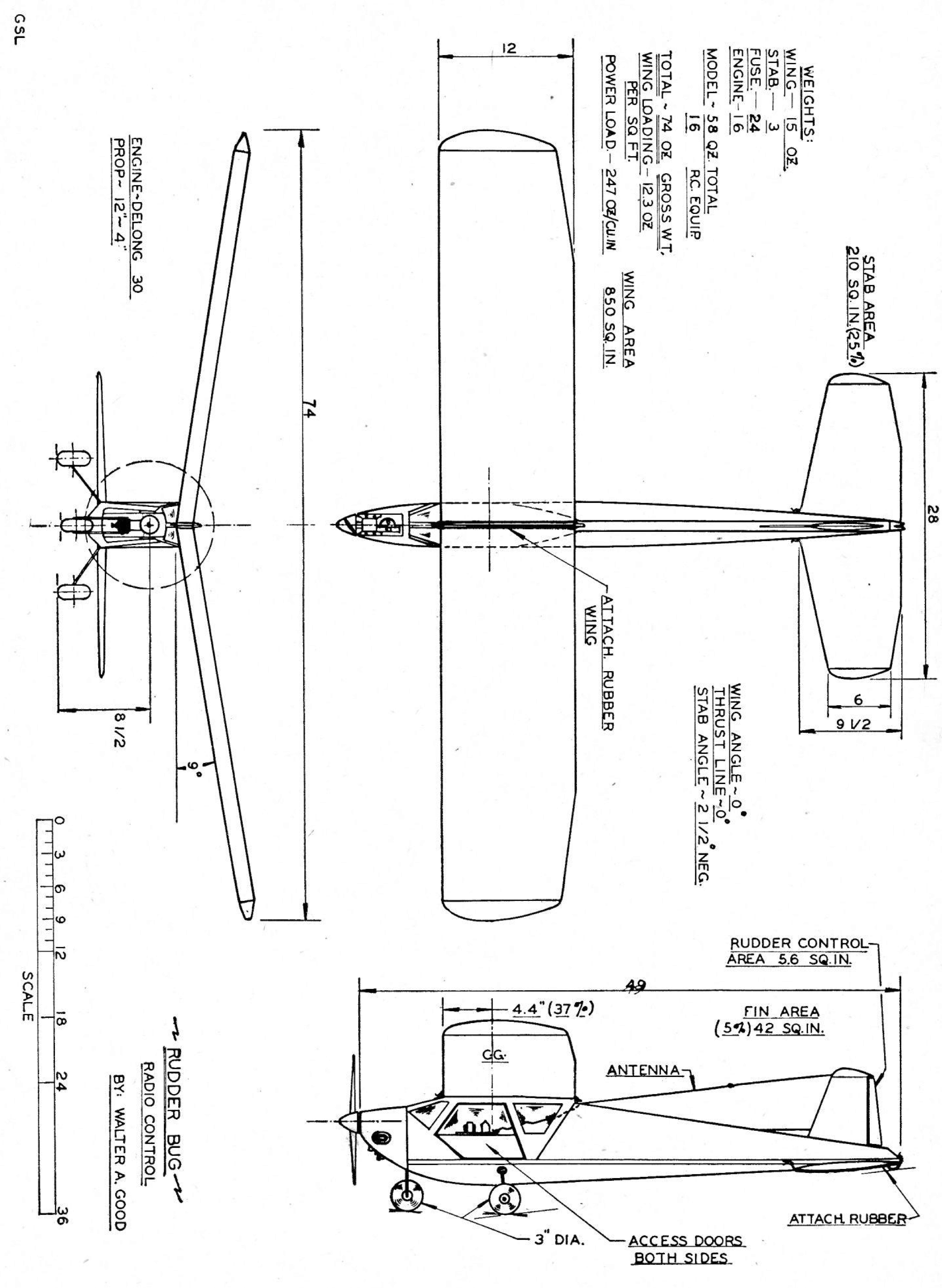
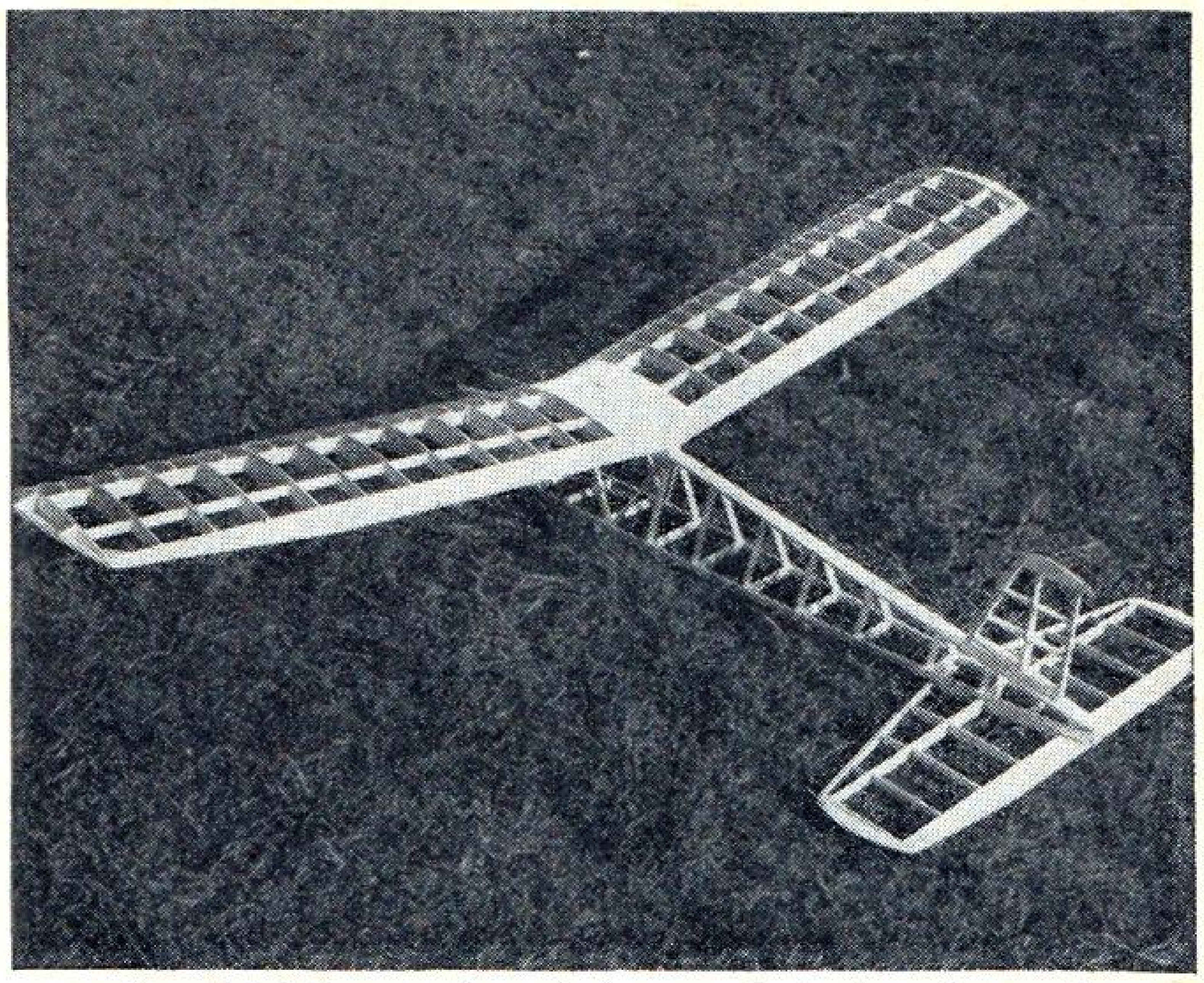

GSL
WEIGHTS:
WING— 15 OZ.
STAB.— 3
FUSE.— 24
ENGINE— 16
MODEL— 58 OZ. TOTAL
16 R.C. EQUIP.
TOTAL ~ 74 OZ. GROSS WT.
WING LOADING— 12.3 OZ
PER SQ. FT.
POWER LOAD.— 247 OZ/CU.IN
STAB AREA
210 SQ. IN. (25%)
WING AREA
850 SQ. IN.
ENGINE~DELONG 30
PROP~ 12"~4"
12
74
28
6
9 1/2
8 1/2
9°
ATTACH. RUBBER
WING
WING ANGLE ~0°
THRUST LINE ~0°
STAB ANGLE ~ 2 1/2° NEG.
RUDDER CONTROL
AREA 5.6 SQ.IN.
49
4.4" (37%)
FIN AREA
(5%) 42 SQ.IN.
C.G.
ANTENNA
ATTACH. RUBBER
3" DIA.
ACCESS DOORS
BOTH SIDES
0 3 6 9 12 18 24 36
SCALE
~RUDDER BUG~
RADIO CONTROL
BY: WALTER A. GOOD

RUDDER BUG

PART ONE



Completed framework ready to cover is simple and rugged

By Walter A. Good

THE *Rudder Bug* exemplifies the new trend in radio control models—simplicity. It is a far cry from the prewar "giant" R.C. models and a pleasant departure from freeflight gas R.C. conversions. Here's a model designed especially for existing radio equipment; it embodies many design features which are unique for radio control models.

In recent years it has become steadily apparent that the radio control gear is no longer the limiting factor in controlled performance. Strangely enough, the number one problem is the design of the model! The general impression of radio control builders at the 1948 Nationals was that final performance depends about 75% on model design, and 25% on radio gear—of course, with lots of practice added.

Thus, since the model design has assumed such importance, what are the design factors involved? Briefly they are: overall size and payload, stability, number of controls, engine power, accessibility of gear, poweron-poweroff characteristics, landing gear, and ruggedness. These factors are discussed in detail below.

The *Rudder Bug* has almost 6 sq. ft. of wing area, the wing spanning 6′ with a 12″ chord. It weighs in at 74 oz., which includes 16 oz. for the radio gear. The 1 lb. payload is easily carried. The body has a semi-scale appearance with a cabin which sports two king-size access doors. The length is 49″. The tricycle landing gear makes for good take-offs, and landings too. Power is an inverted *DeLong 30*. The radio control gear is a standard Beacon Electronics set, consisting of a transmitter, receiver and rudder escapement. Only rudder control is used which has been found to be very effective, hence the name *Rudder Bug*.

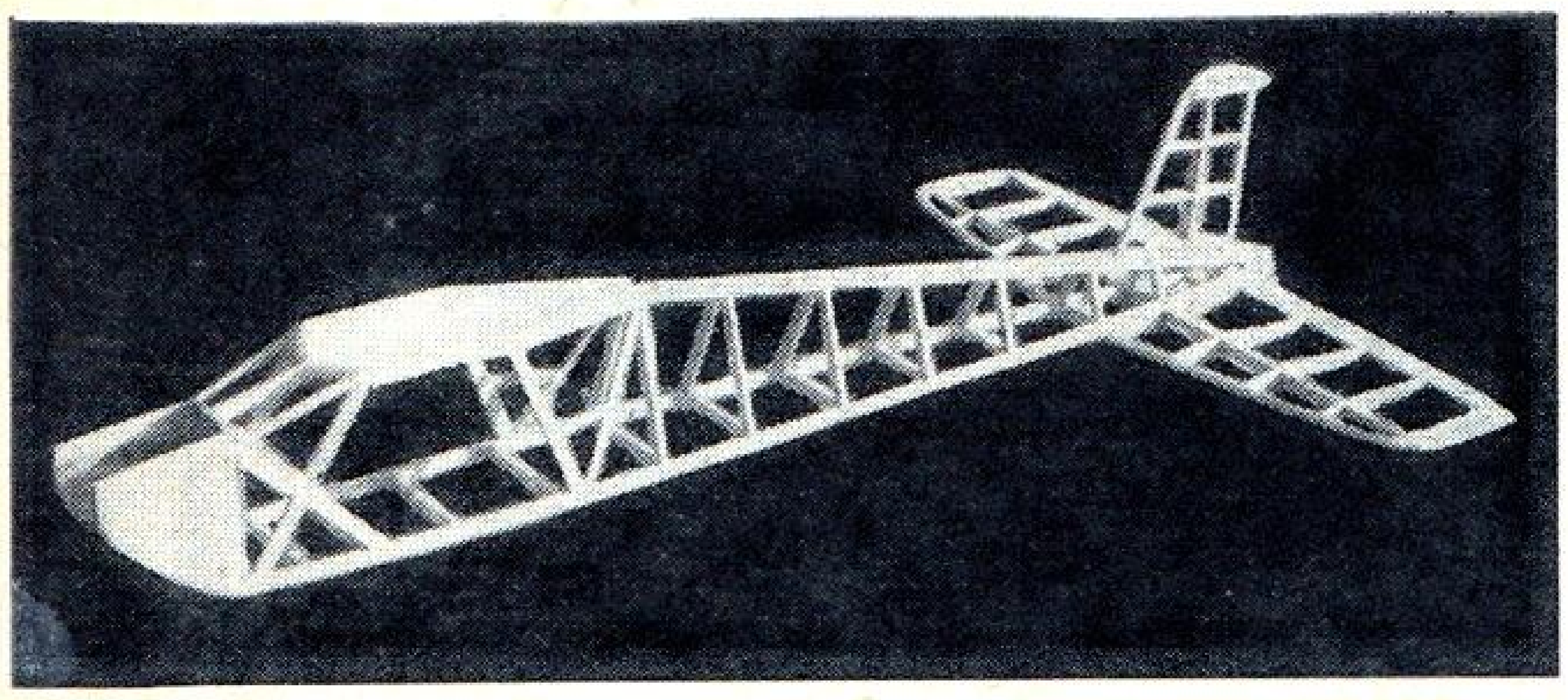
The *Rudder Bug* was in the drawing stage for several years. Almost a year of limited sparetime was consumed in the building—it wasn't quite complete in time for the 1948 Nationals! During six months of flying, the ship has logged 63 flights and verified many of the design ideas involved. Now let's talk about the design.

Large R.C. models (above 8′ span) are certainly beautiful flyers, as demonstrated by Charley Siegfried and others. They, unfortunately, do have two distinct disadvantages—they are awkward to transport, and require many long hours of building and repair time. How about small (below 5′ span) models? They are easy to transport and build.

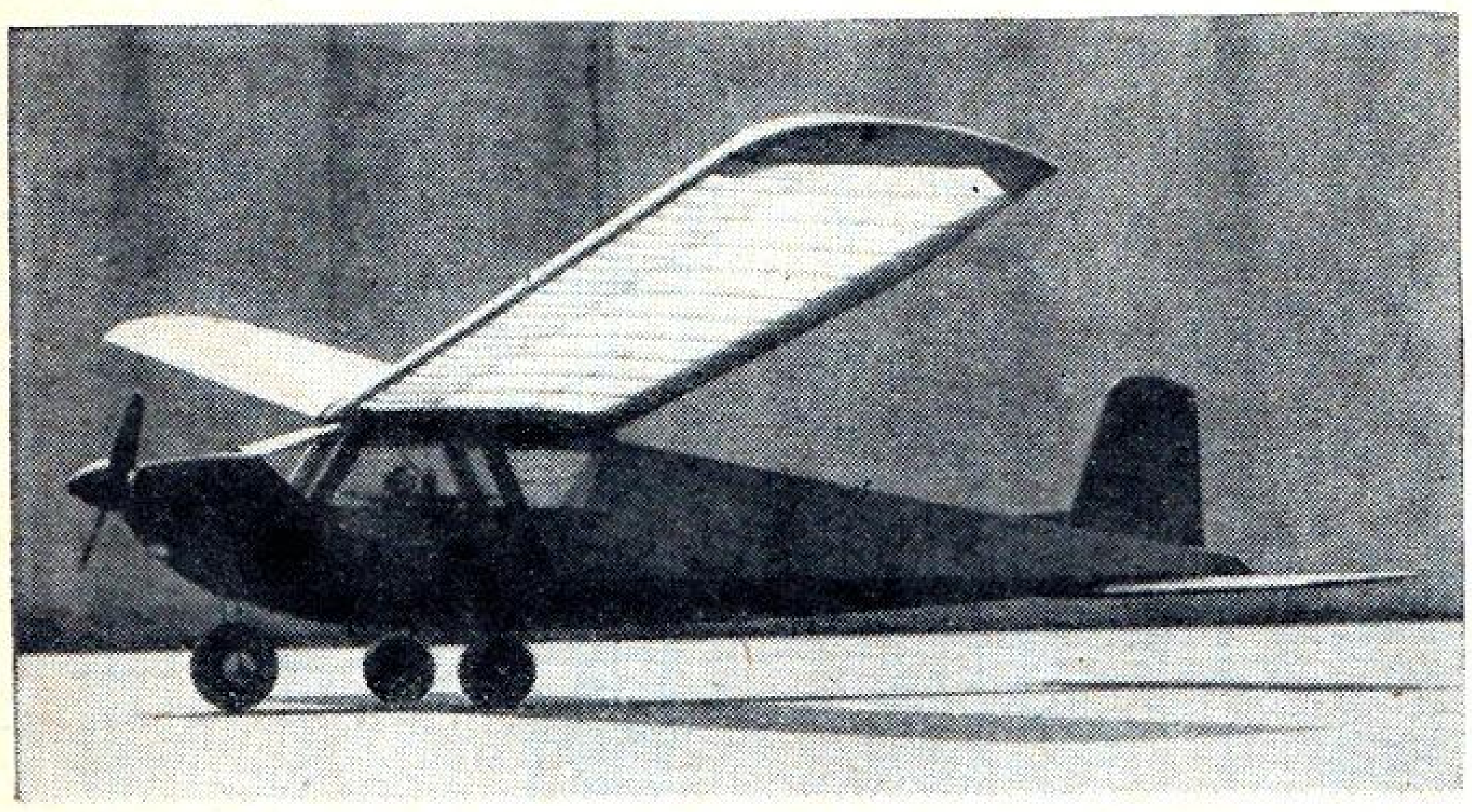
It has been observed, however, that they rapidly shrink from view during flight maneuvers, giving the operator the feeling he's "controlling" a small dark blob rather than an airplane structure. Small models may have difficulty carrying the necessary radio gear with ease. The 6′ size of *Rudder Bug* is felt to be a reasonable compromise. Note how this size lends itself to conventional types of construction.

Good longitudinal and spiral stability are prime requisites of the radio control model. For this size model, Frank Zaic suggested that a 25% stab would be about right for a quick

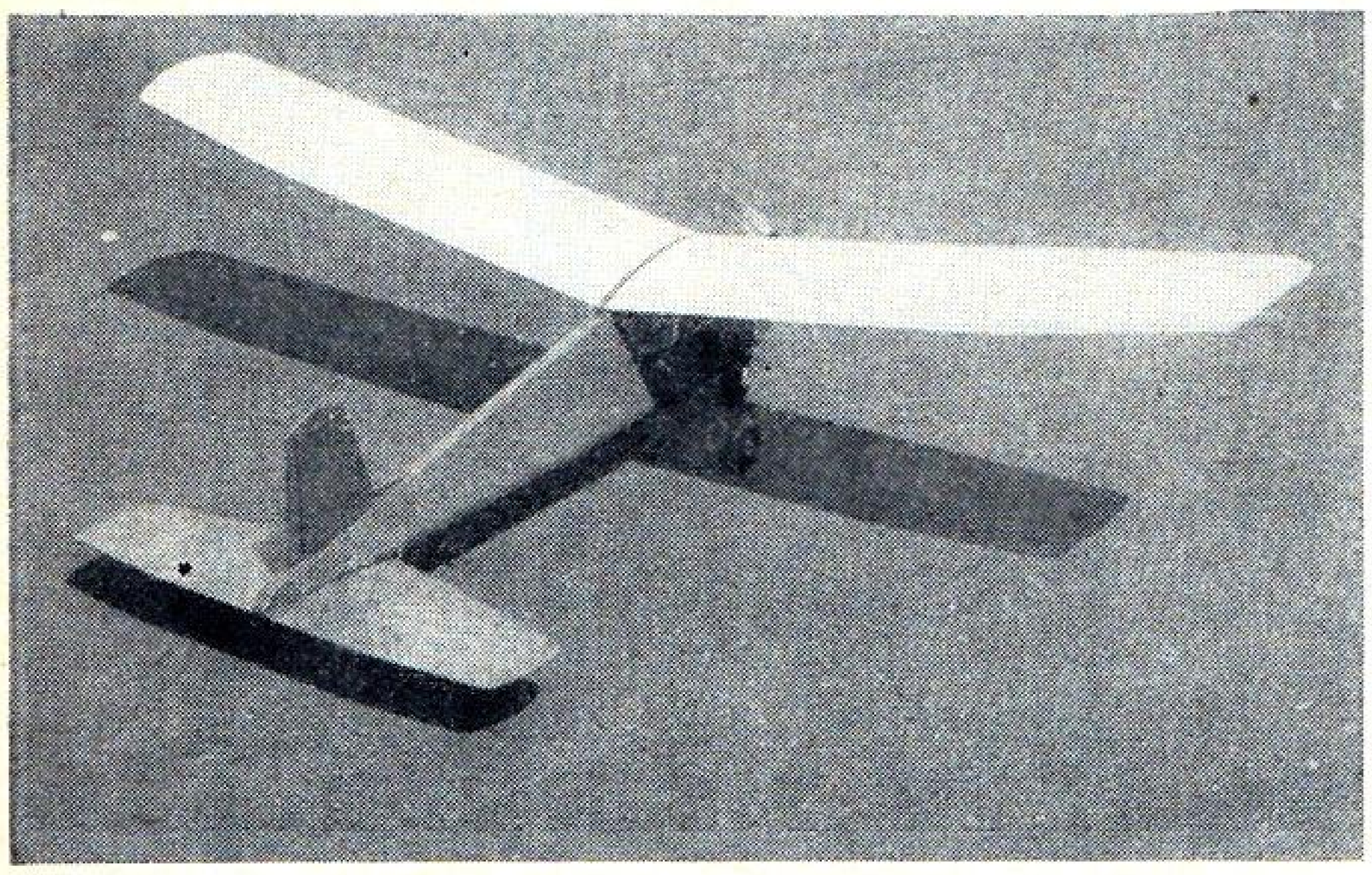
(*Turn to page* 37)



Area under wing is designed to give large unobstructed space

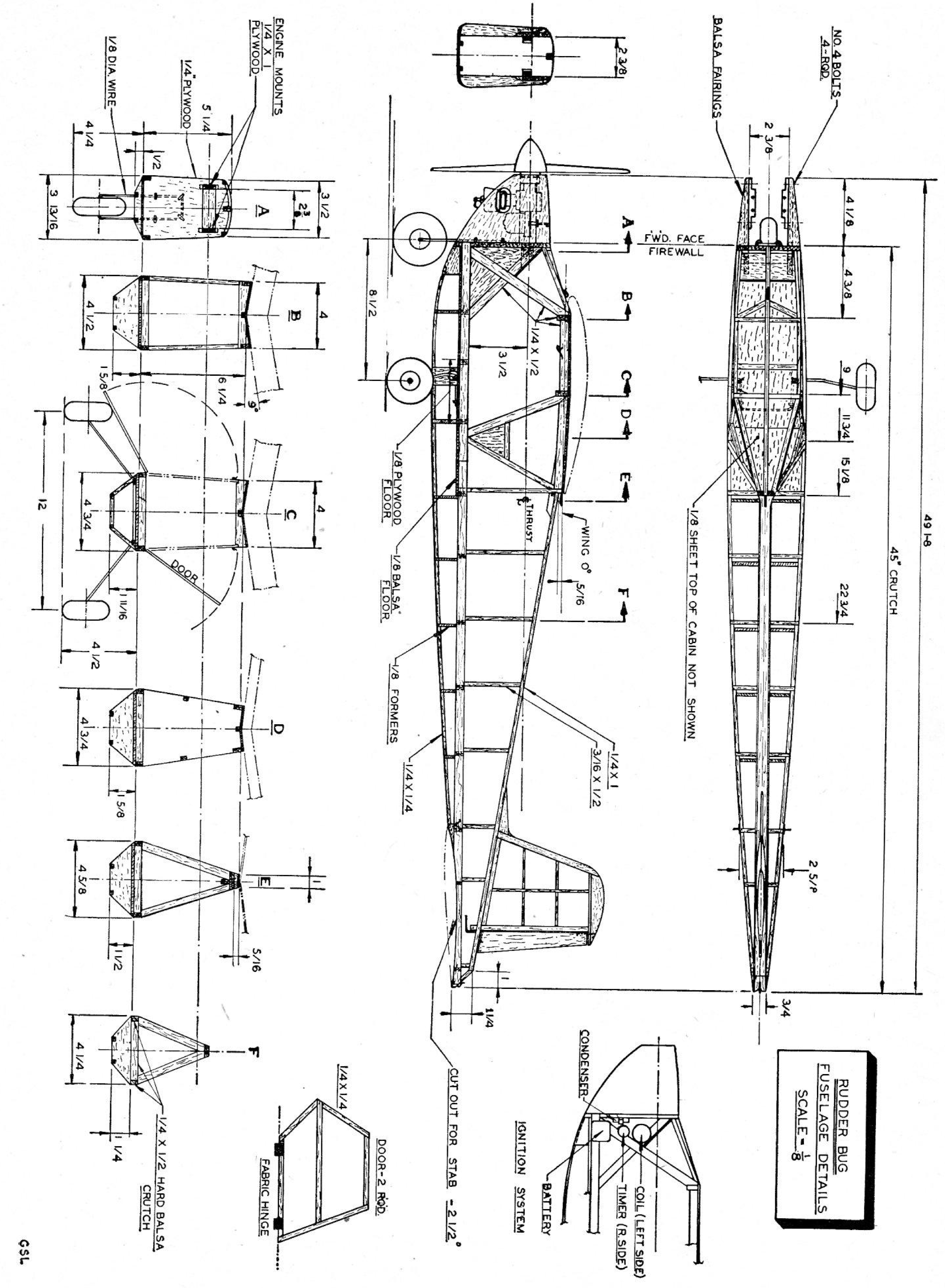


Tricycle gear assures good take-off and taxiing qualities

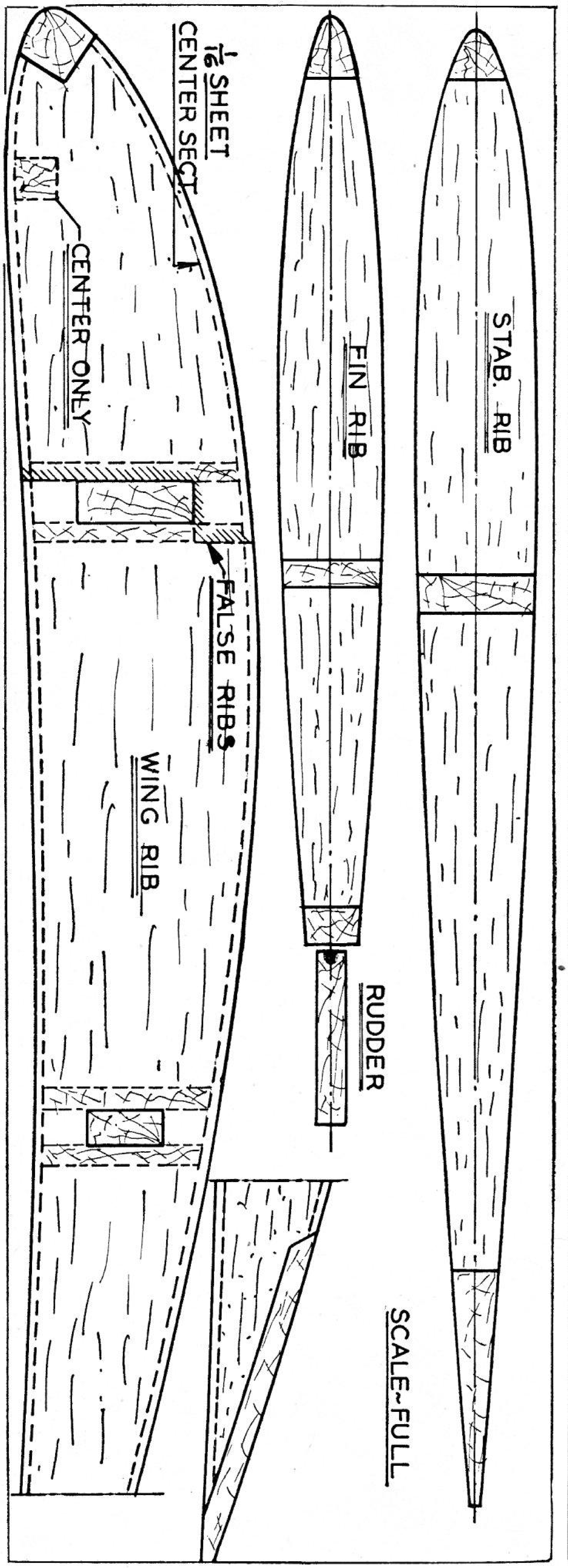


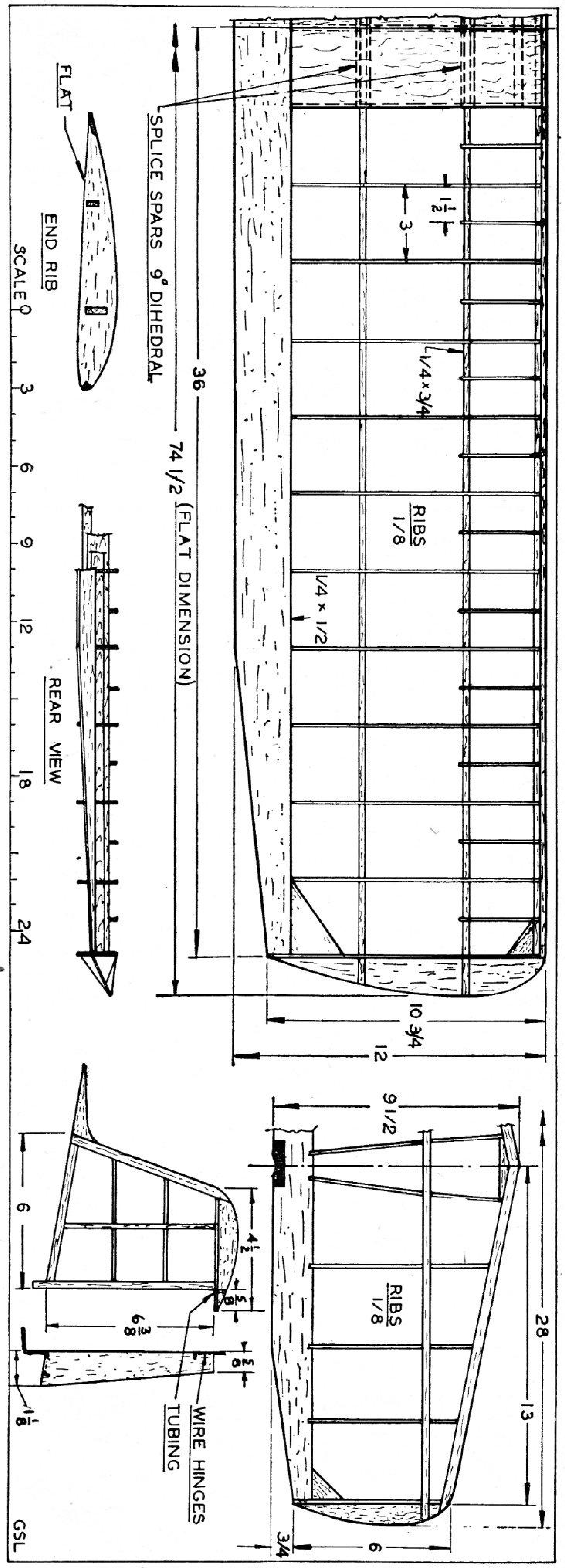
An attractive model, *Rudder Bug* was designed for a purpose

Walt Good has retired faithful old Guff, a real veteran, and has produced this up-to-date design for radio control



RUDDER BUG
FUSELAGE DETAILS
SCALE - 1/8
NO. 4 BOLTS 4 - RQD.
BALSA FAIRINGS
FWD. FACE FIREWALL
49 1-8
45" CRUTCH
1/8 SHEET TOP OF CABIN NOT SHOWN
1/4 X 1
3/16 X 1/2
WING 0°
THRUST
1/4 X 1/2
1/8 PLYWOOD FLOOR
1/8 BALSA FLOOR
1/8 FORMERS
1/4 X 1/4
CUT OUT FOR STAB - 2 1/2°
CONDENSER
COIL (LEFT SIDE)
TIMER (R.SIDE)
BATTERY
IGNITION SYSTEM
ENGINE MOUNTS 1/4 X 1 PLYWOOD
1/4" PLYWOOD
1/8 DIA. WIRE
DOOR
DOOR-2 RQD.
FABRIC HINGE
1/4 X 1/2 HARD BALSA CRUTCH
A
B
C
D
E
F
GSL


1/16 SHEET
CENTER SECT
CENTER ONLY
FALSE RIBS
WING RIB
FIN RIB
STAB. RIB
RUDDER
SCALE~FULL


SPLICE SPARS 9° DIHEDRAL
FLAT
END RIB
SCALE 0 3 6 9 12 18 24
36
74 1/2 (FLAT DIMENSION)
1 1/2
3
1/4 x 3/4
RIBS 1/8
1/4 x 1/2
10 3/4
12
REAR VIEW
9 1/2
28
13
RIBS 1/8
6
3/4
6
4 1/2
5/8
6 3/8
3/8
1 1/8
WIRE HINGES
TUBING
GSL

Rudder Bug

(*Continued from page* 11)

longitudinal recovery. This has been verified in the air. The high lift NACA 6412 wing section is set with its bottom at 0° incidence. The C.G. is at 37% of the wing chord, and the stab is set at —2.5°. During tests, the C.G. was varied from 25% to 40% accompanied by the corresponding stab setting, with the above figure giving the best recovery.

The good spiral stability of the model is attributed primarily to the proper relationship between dihedral and fin area, plus the "washed-out" wing tips, which reduce wing tip drag. The wing has 9° in each panel, or a total of 18° dihedral. The fin area is 5%. The wing tips have a built-in negative twist of about 2.5° which also helps prevent tip stall and promotes clean recovery.

How many controls should a radio control model have? The author believes that if you want to spend lots of time in the air and very little on the ground, then you should choose the most effective control combined with the greatest simplicity and reliability. Currently, the author prefers rudder control. It must be pointed out that the infancy of the radio control game has not allowed real standardization of "the" final system. Many other systems suggest themselves. Rudder with coupled elevator to give tight nose-high turns looks good. Maybe ailerons alone would do? A butterfly tail with its combined rudder and elevator could be worked out. The *Rudevator* of Owbridge and Schumacher has been perfected and gives coupled turns plus up-and-down. These are but a few of the possibilities. Many flight tests of these and other ideas will be required before standardization occurs.

The fantasy that radio control ships need large engines was finally dispelled at the 1948 Nationals, where several ships appeared with Class B engines! The *Rudder Bag* mounts a *DeLong B* which does very nicely; in fact, on some flights it would have been desirable to throttle it back after reaching maneuvering altitude. The important point is to use a steady, reliable engine—not a host of power. After all this is not a screaming contest ship!

The accessibility is measured by the ease with which you can get at the receiver, the batteries, the escapement, and the wiring. Two large doors, one on each side of the cabin, give entrance to the receiver and battery compartment. Converted free flight designs usually cannot afford such large access openings because their structures would be too greatly weakened. The doors, which hinge along the bottom edges, allow quick checks of battery condition and adjustment of the receiver. The escapement and its linkage are mounted within the fuselage just below the fin and are reached through the bottom of the fuselage when the stab is removed. The escapement rubber band threads forward in the body and is wound through the cabin door. Winding once a week is recommended! Removal of wing and stab does not interfere with any of the radio installation, thus you need only the fuselage for radio testing, a handy consideration in a small workshop. Because the cabin roof is covered, there are no dust catching holes when the model is stored. This also protects the sensitive relay contacts from excessive contamination.

It is desirable that neutral rudder result in straight flight with engine power both on and off. Similarly, fixed left and right rudder deflections must produce equal sized circles. Can you adjust your contest gassie to do this?

Of course, if the normal torque effects could be eliminated, the problem would be solved. A method is used here which does not eliminate the torque effects, but greatly reduces them. This type of model would normally be expected to turn left under power. A large portion of the "left turning" torque is due to the spiralling prop wash acting heavily on the left side of the fin because the fin is usually well above the thrust line. In this model the fin has been lowered drastically such that the thrust line is directed through, or slightly above, the center of the fin area. As a result, this model flies straight with no motor off-set! An earlier model which had the whole fin completely below the thrust line turned violently to the right "against the torque" with all adjustments neutral. So don't ignore the spiralling slip-stream. Gene Foxworthy has another solution by removing the fin from the slip-stream and using double fins on the tips of the stab.

Proneness of the two-wheel gear on the old *Guff* to cause ground loops led us to try something different. Jim Walker's demonstration of his tricycle gear provided the answer. While all three of the wheels are fixed it still is possible to "steer" the model with the rudder during the take-off phase. Long, lazily realistic take-offs are made comparatively easy. Landings, too, benefit from the fact that very little bounce results, even on a hard runway. "Flat" landings have been made which exhibited no perceptable bounce followed by a terrific roll she really needs brakes! Remember the wheels absorb most of the landing shock, so choose good rubber ones, especially for that poor nose wheel.

Real ruggedness is required to withstand violent maneuvers and an occasional rough landing. Experience has shown that the radio equipment is far more shock resistant than the model. So if you have to retire from the field early, it's more likely to be due to an unrugged model. Also, there is a payload aboard which stresses the model structure too. Plywood firewall and plywood landing gear platform aid the strength. The nylon covering has held up well even through two bad landings; one in a tree, the other downwind into a fence. In fact, total damage was a broken prop and a few dents. The nylon is strongly recommended.

Since most of you are familiar with standard building methods, only general construction notes will be given. The materials should be carefully selected. All pieces may be cut from standard sizes except the two crutch longerons, which require splicing. Due to the crutch type construction, most of the body can be built before removing from the board. The 1/8" diameter steel landing gear wire is fastened in position with "J" bolts. The motor cavity is suitable for a variety of engine sizes. Note: motor beans are replaceable. The slab-sided nose is not as pretty as a cowl, but is certainly easier to make and is a practical expedient.

Attention is called to the 1/8" floor in the forward section of the body. Batteries are mounted along this floor. Wing and tail fasten to the body by conventional rubber band methods. Use plenty of glue on all joints; two or three coats will repay the effort in greatly added strength.

The wing spars were first carefully joined at the correct dihedral angle and then the ribs and other parts were assembled. The trailing edge of 1/8" was copied from Effinger's *Buccaneer*. To produce the built-in negative twist in the tips, build the entire wing flat with "square" tips. Then slice off the angled trailing edge and shape the bottom of the ribs to fair smoothly into the trailing edge. The tip rib should have a perfectly flat bottom. The nylon covering worked best for the author by covering "wet" the same as silkspan. This way no stretching is required although repeated wetting may be needed because nylon dries quickly. The model was doped with three coats of clear and two of color which naturally was a deep orange.

The fin is symmetrical and is cemented to the body after covering. The movable rudder is made from very light 3/16", which is intentionally left thick to operate effectively. Make sure that the rudder moves easily without stickiness. A 7° angle or about 1/8" deflection of this rudder gives a very tight turn so start your test flights by pinning it in a neutral position.

The stab has a symmetrical section and a full depth spar. Keep it light to prevent tail heaviness.

A breakdown of weights is listed on the drawings to be used as a guide.

The original model was test flown with no radio gear aboard. The purpose was to obtain approximate trim adjustments, become familiar with the model's characteristics and provide a "shakedown" test. With no payload the wing loading is about 10 oz. per square foot, which makes testing easy. Balance the model at 37% (4-1/2" behind leading edge) by adding weight at the nose or tail. Check the motor for no off-set. It is assumed all warps have been removed. Glide test for a clean fast glide with no sign of a turn. Alter stab and rudder settings to accomplish this. When satisfied, you are ready for power flights.

Using medium power and a 20-30 sec. motor run, try an easy hand launch into the wind. The first job is to adjust for straight glides by changing the rudder angle. Then, if necessary, adjust motor angle for straight power flights. You can stop now, but if you wish, several flights may be made with small amounts of left and right rudder to observe the turning characteristics. However, remember that 1/8" of rudder is a very tight turn, so go easy!

Part 2 will detail the installation of the radio gear, ground check procedures, and radio control flying tips.